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SUNLIGHT.

BY THE AUTHOR OF

"THE INTERIOR OF THE EARTH."

Second Edition,

WITH ALTERATIONS AND ADDITIONS.

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OPINIONS OF THE PRESS.

"A new and remarkable theory respecting the birth of the world has been started by Mr. Malet, with light as a distinct force from heat. Light is shown to have a separate existence from heat, and to be associated with matter to form organic bodies for a temporary existence. His new pamphlet is very interesting and instructive."—*Salisbury and Winchester Journal.*

"As to the theories which Mr. Malet has sketched out in these letters, it may be safely said that their ingenuity will interest the scientific reader, while the knowledge they display . . . will at once instruct and interest readers in general."—*Northern Whig*, September 2, 1884.

"Mr. H. P. Malet . . . deals with one of the most profound subjects of scientific speculation, and seeks to account for all the phenomena of the earth's history by the action of sunlight alone as the universal agent of the Creator. . . . The letters will be found suggestive, and in many passages marked by considerable beauty of illustration."—*Reading Mercury*, 3d August 1885.

ERRATA.

Preface, page v.—Leave out "and editions," and read "by the same author, published in."

Page 70, first line, for "depreciation," read "deprecation."

PREFACE.

MUCH has lately been written on Sunlight and Heat; but no two writers coincide on the origin of either, or in the age of the sun. Some tell us that the words of the Bible are enough for man to know; he is not content with the abstract, and until the sciences coincide in their conclusions, he will continue his speculations on these subjects. The sections before us are all founded on personal observation of natural facts. Some were first published by that truth-seeking paper, *The Northern Whig* of Belfast. These were then issued by Messrs. Robb of that city in a small edition, which went off quickly. So much information has been given to the public since, bearing on the point before us, that it is advisable to issue a second edition; embodying that which seems to give evidence for, and opposing some theories that try to disprove the facts of nature. It is now nearly a hundred years since our English cosmogonists generally accepted the "System of the World" as published by the French astronomer Laplace. In doing this they lost the main point of creation, adopted the emblem of destruction, and did away with *light*, the sole cause of creation, as taught by

the Bible. It is not only because the word *light* is used there alone that I use it now, but because, in a long looking at natural actions, I have found that light without fire is now, and must ever have been, the cause for action in the elements of which this world is formed. It would take many years to go through all the speculations on creation. It will be seen in the text that more labourers are required before the present views of modern science can reach the hoped-for maturity of their fire theory. If they will consent to try the road by the Sunlight that I humbly suggest for their guidance, it is not improbable that they may reach a satisfactory conclusion earlier than they expect.

It is as well to look back a little before showing the utter confusion that has risen in the scientific world by the neglect of one word.

In the translation by J. Pond, 1809, of "The System of the World," P. S. Laplace, we find at p. 363 :—

"This view, therefore, of planetary motion leads us to think that, in consequence of excessive heat, the atmosphere of the sun originally extended beyond the orbits of all the planets (*i.e.*, a distance of about '2,745,998,000 miles'—*Skertchly*), and that it has gradually contracted itself to its present limits. . . . We may then conjecture that they (the planets) have been formed at the successive bounds of this (the sun's) atmosphere. . . . One may likewise conjecture that the satellites have been formed in a similar way by the atmosphere of the planets."

These plausible conjectures of the French astronomer have been accepted as facts, though he and others were unable to find a cause for the beginning of heat, or

any reason for its continuance. Heat and light are before us.

If these points had been settled, the present schools of science could not have been in the confusion that is now to be shown. The fourth edition of "Geology," Professor Geikie's "Science Primer," edited by Professors Huxley, Roscoe, and Balfour Stewart, article 246, tells us:—

"Regarding the earlier stages of the earth's history no direct evidence is now to be obtained from the rocks. When the earth was detached from its parent sun, it must have been a fiercely hot mass as the sun is still."

On turning to the "Physical Geography Primer" by the same author, and editions published in 1885, article 264, we find:—"Since the openings into the interior of the earth (*craters*) are so numerous over the surface, we may conclude that the interior is intensely hot." Science, resting on uncertain data, mistakes a local for a general earth-heat, and we do not know that the sun is hot. Most of our modern geologists accept a fire world as an established fact, and Professor Croll in "Climate and Time" finds the hot beginning from this hypothesis, and makes beautiful calculations on heat without finding its origin. The molten world is taught in all geological schools, and scholars laugh if they are asked to prove the fact.

In the midst of all this scientific certainty the *Times* of September 2, 1886, reports the address of their President, Sir W. Dawson, to the British Association; in this we find that the similarity of volcanic action all round the world "led to the old idea of a fluid interior of the earth, but this is now generally abandoned." The Pre-

sident, however, hesitates, and finds a difficulty in action; so he said:—

"The contraction of the earth's interior by cooling, and by the emission of material from below the over crust, has caused this crust to press downwards and therefore laterally, and so to effect great bends, folds, and plication: and these modified by surface denudation constitute mountain chains and continental plateaus."

This cooling and contracting, with upheaval, is a fashionable theory just now, as we shall presently show. The contraction was a necessary result of a nebulous origin, but the cooling was all ideal, and the hot beginning is abandoned. Sir W. Dawson substitutes a hot magma for it, and on my writing to him for some explanation, he refers me to "Chemical and Geological Essays," by T. S. Hunt. At page 70 he writes that Professor Joseph Le Conte suggests "*The whole foundation of theoretic geology must be reconstructed on the basis of a solid earth.*" All the igneous system is, then, theoretic. Mr. Hunt, however, follows Keferstein and Sir John Herschel in thinking that the "deeply-buried and water-impregnated strata between the superficial crust of the earth and the solid nucleus constitute a region of plastic material adequate to explain all the phenomena hitherto ascribed to a fluid nucleus." We shall see that this magma is neither natural nor necessary. Sir W. Dawson finds this out when he came to the ocean. "This leads us to the further consideration that while the ocean-beds have been sinking, other areas have been better supported, and constitute the continental plateaus." This is really the natural result arising from a cool nebulous mass being converted into

air, water, and solids under the lawful creating action of light on gases sensitive to it. This has been suggested long since, and forms the subject of this book. Sir W. Dawson goes on to say, "It has been at or near the junction of these sinking and rising areas that the thickest deposits of detritus, the most extensive foldings, and the greatest emissions of volcanic matter have occurred." It does not seem to have occurred to him, or to many other modern geological writers, that these deposits are made from the waste of dry land, that they are left where we find them, because the water forces could carry them no farther, that as deposits they had in them gaseous materials, and were permeable. In overlooking these facts they have overlooked the unavoidable contraction, consolidation, and subsidence of these areas. By these actions all the foldings and plications are simple natural consequences. In these actions friction, pressure, or chemical causes must ignite the gases of these deposit areas, and, dependent on the igneous condition, volcanic action must ensue. It is the contraction of these areas that causes earthquakes, and it is the chemical condition of such localities that gives out the hot springs. In regard to lateral effects of contraction, as causing upheaval, Sir Charles Lyell gave up the point in his letter to the Duke of Argyll in August 1874, when he said that all the evidence "runs quite in a contrary direction."

A book full of this tentative science might be written, but enough has been said to show the confusion of present schooling. The one word missing is Light; its results on gases or on their products is therefore wanting. The persistent or fickle forces of wind and water flow from the

action of light; they leave the productions of ocean and of dry land along our shores. All the plateaus of our present continents are built from these products by these actions, resulting in more land by a longer light in the northern hemisphere. In these buildings gases and combustibles with their heating chemical causes are buried; from these burials we get volcanic eruptions; and from the sapping of these burials at varied depths by fire and water we get our earthquakes. The similarity of volcanic action is due to the burials being chiefly of similar materials, but the late earth actions in New Zealand tell of different constituents. In whichever way we look at these actions and materials, there is no difficulty in tracing all to light, acting on matter sensitive to it: that matter absorbed sunlight to maintain its own light of life; caskets of earth material retained that light and give it back as fire from those materials. The whole process tells of a God of Light, of a creation by the Light of Life. By this light we get our expansion of gases as evaporation; on this follows the condensation and fall of the liquid gases as they meet the colder air; then follows the rarefaction of our air by cold pressure, getting rid of all earthy particles till the upper air meets the impalpable cold ether of space without friction. From these pressed-out earthy particles Laplace thought our meteors came, a much more likely theory than from comets, as Professor Newton taught the American Association for the Advancement of Science, in August last.

As much information poured in, after most of the sections were published, it was advisable to include what was necessary in a short appendix; in this there is much direct evidence in favour of light alone as the creative

agent acting on the materials that first formed this earth; but the doubts, the hesitations, and want of definitions are negative evidences of the failure of the fire-made world theory. The present school of physics and cosmic action is on its trial. All that is wanted is a true beginning; and in the confusion now existing there is ample room for the serious consideration of my simple suggestion, that light was the first cause of the creation of this earth, acting on a nebulous mass that held in it gases or material sensitive to, absorptive, and retentive of that light.

H. P. MALET.

April 1887.

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SUNLIGHT.

SECTION I.

SUNLIGHT AND MATTER.

THE object of these chapters is to expand the Mosaic teaching—"God said, Let there be light," as well as to show that light without fire did create this earth and all life on it. The light of the sun fell upon a sensitive nebulous gaseous mass, gravitating in space, and this earth was born. There are two things to be accounted for in this sentence. First, the sunlight; second, the nebula. Unless we can find a credible origin for both outside the now incredible and "generally abandoned" system of the world as laid down by Laplace, it is impossible to get on with a comprehensive history of cosmology, or its consequence, geology. From the time of Solomon down to this day, the cause of sunlight has not only been unknown, but attempts at the discovery have been ridiculed. The idea of Laplace is still fashionable with some. Intense heat was the only means he knew of by which his imaginary nebulous mass could occupy the place of our present solar system, with a circum-

ference, in round numbers, of 16,500,000,000 miles. He got his light from this supposed heat; but his nebula broke up into rings, which are supposed to have condensed into the known eight planets, an uncounted number of asteroids, several moons, and finally the sun. He thought it possible that the sun had gained heat by absorbing all comets that were within his influence. But his main source of heat was gravitation. Professor Croll endeavoured to account for the ideal heat in the sun, concluding a long scientific inquiry in "Climate and Time." If gravitation was not sufficient to account for heat expended, then it must have been supplied from some "source or other." In this expressed ignorance of the cause for sun-heat, in our inability to comprehend why there was only one nebulous mass for the whole, instead of a separate one for each known body of the solar system, or why this nebulous body should have acquired any heat, by moving in an intangible ether, which gives no heat to bodies or to nebulæ moving in it now, it seems fair to give up the question of destructive heat, and take up that of constructive light as a separate force, and as the only celestial fact we know of in the sun.

However difficult it may be for us to imagine light as separate from heat, we find around us many examples—fireflies and glow-worms of divers kinds, fishes in the cold sea hanging out their love lanterns. Nordenskjold tells us, in his "Voyage of the Vega," vol. ii. p. 25, "an exceedingly intense beautiful bluish-white flash of light arises from the snow when touched, and is so intense that it appears as if a sea of fire would open at every

step a man takes. It flashes about in all directions with a light so intense that a fear arises that shoes or clothes will take fire. . . . It comes from a minute crustacean, Mehidi Armata." The light ceases when the temperature is about 15° Fahr. below freezing.

This light of life and of love exists in the vegetable and animal all round the world. We all know that the ethereal, imponderable material, light, is associated with the ponderable matter of earth. The most wonderful care is lavished on the preservation of this light in its inert condition. In most seeds it is surrounded with a cold pulp; in the animal the germ endures extremes of cold and heat better than the adult. There is an artificial mixture called phosphoric paint, which gives out light without heat, also another paint without phosphorus; this, when placed in the daylight for a time, absorbs the light, and returns it, when placed in the dark, according to the time of exposure, without heat. Heat and light are not therefore identical.[1] Most beautiful arrangements exist for the movement of seeds and for the migration of creatures; and, as far as we know, all this care has been attended with the preservation of species in all organic forms from generation to generation, from the time of the creation till the extinction of the kind.

Light is, therefore, associated with matter to form organic bodies for a temporary existence. When this ends, the light of life vanishes, and the materials that had gathered round it to form the body return to their elements; these are dusts, and gases in liquid and aerial

[1] See Appendix.

conditions. In the latter they become liable to evaporation or attraction. As the gases rise, all the liquid parts become condensed in the first cold air they meet, returning to earth as dew, rain, snow, or hail. This process is familiar to us all, and we know that living creatures and solid matter have fallen with the liquids in all the above conditions. If organic forms and seeds, holding in them inert or active lights of life, can thus be raised into the air by the force of attraction, how much more certainly must that light of life be attracted to its kindred light, the sun? While connected with its organic form, that light of life was in direct or indirect connection with the sun; it was, in fact, the sunlight of a temporary world, receiving its light and warmth from its God, and drawing to itself all the constituents necessary to complete its organism. The light that does all this is so ethereal, so intangible, that it has hitherto escaped analysis. We recognise its sensitive qualities in the eye of man and beast; we see it as the beacon of love in transparent creatures; and we see it as a halo of light over seeds in the act of germination. As thus connected with life on earth and light from Heaven, this light must be sensitive though impalpable matter, and as such must be sensible to the attraction of the larger light, our sun. Under ordinary circumstances these sensitive gases, once the life-lights of organic bodies, are for ever escaping; but there are times when this escape is more abundant; and it is at harvest and leaf-fall seasons that we sometimes see these gases escaping from such earthy materials as may have risen with them.

We come now to facts noticed by Laplace. He tells us that dusts of earth rise with the gases, till they meet a stratum of atmosphere "sufficiently rare for them to rest in equilibrium." He tells us that our meteors are formed from these dusts, and I pointed out in a former letter how cold and pressure separated earthy solids from aerial gases, as Mr. T. S. Hunt quotes in his "Chemical and Geological Essays," "Frost performs the effect of fire." Under this beautiful process the most rarefied and purest gases are set free to meet the love of the sunlight. They reach the confines of our atmosphere in the same intangible condition as the ether of space; if it were not so, there would be more or less friction between the revolving sphere and the ether; they arrive there as waves of light come from the sun; and there in their purity they meet his force of attraction, acting "with a velocity which we may consider as infinite, and we may conclude that the action of the sun is transmitted in an individual instant to the extremities of the planetary system" ("The System of the World," pp. 234–5, vol. ii., P. S. Laplace's translation, J. Pond, 1809). If this is the mode by which the gases of this earth, in their simple or combined conditions, and by analogy of all the members of the solar system, reach the sun (supposed to do so by Sir Isaac Newton and Sir W. Siemens), then we have a unity of action, and a mutual connection between all his worlds and their centre light, of which relationship man in his own body, and every other organic form in the animal or vegetable kingdoms, are pure and simple types; they are all supplied with the light of life, given by the Creator, fostered

and renewed by His agent the sun; all with a temporary attraction to their own centre light; warmed by the gases of earth, as sensitive to the light of heaven; all returning that light to be purified in the cold of space, to be freed from all earthy matter; on purpose to be qualified for that instantaneous flight to the heart of the universe, to become again the light without fire for ever glittering round upon His worlds of love.

It is hard for man to comprehend that the heat which burns his skin in the sunshine, that heats the silicious rocks till they are unbearable to his touch, and that hatches the eggs of the turtle in the sand, does not come direct from the sun. He forgets that he is made of the substance of his mother, and that this substance was once in a gaseous condition, with constituents more or less sensitive to the action of light. He knows that his artificial lights have heat; that this heat, when it has reached its limit, does not begin to warm him again at a greater distance; but he knows that the heat he feels in the sunshine only extends to a short distance above his head, to cease there, and to be replaced by cold and eternal frost. Why is there this difference between natural and artificial light? One is of the earth, the other of heaven; this a regenerating light, that is destructive. The sunlight may, indeed, destroy, but only in cases where the gases or liquids of earth have not supplied the demand to maintain life. But it will be asked, Why is it cold nearer to the sunlight? Simply because the light-absorbing and heat-giving gases are in or on the surface of earth, while the non-absorbing, and, therefore, cold gases are for ever rising to fulfil their

destiny. That destiny is to be purified from all the dross of earth, so that they may move on, till wave on wave they become purified, and qualified to accept the embrace of the sun. In that embrace Newton's spirit of light, or the light of life, becomes again a contribution to the sunlight, which in these conditions is not necessarily a globe of heat.

We now come to the second point. How came the nebula in space? We have just shown that wave on wave of gases must be always rising from this earth. By analogy the same action must go on in all worlds, not only in our own solar system, but in all the host of heaven. Gases may escape from worlds into the space beyond, or they may combine in space. These gases must be of varied combinations, and therefore more or less under the influence of light. The effects of light on the gases of this world have been described above. Sir William Herschel imagined that all nebulæ were gaseous bodies in course of consolidation. He found more of them in the northern than in the southern hemisphere. It has been shown how this earth consolidated by the attraction of its gases from its solids, and by the return to it of what has been called meteoric dust. This filtration is due to cold and pressure; but as wave on wave of gases perpetually roll from the body to the sky, so some gases may reach the confines of the earth's atmosphere before they have lost all their earthy material. In this state such gases cannot be as sensitive to light as those which have lost their worldly combinations; therefore they remain suspended in and moving with our atmosphere. If earthy gases escape into space

they may combine, and in such conditions one nebula may attract another, and thus great bodies may be formed to become the nebulæ we see. These collections of gaseous bodies in space must have been going on before worlds were born; they were in fact the beginnings of all, for no worlds were formed first as solid bodies, and, even in the vast mass contemplated by Laplace, it was all gas, expanded into a circumference in round numbers of 16,500,000,000 miles, from intense heat, as he thought. It has been shown that science cannot find the origin of heat, and that there is no occasion for it. If, then, it was only by heat that his imaginary gaseous mass expanded, that mass could not have existed; but as the beginning of worlds was necessarily gaseous, we are forced to acknowledge the existence of such bodies in diverse conditions, with the natural result that all the planets of this solar system, holding in them materials like to one another, are in different conditions now. If all these planets had been thrown off by centrifugal force from one mass, as supposed by Laplace, there is no reason why they should not have been identical in constitution. As they are not, it is a proof of separate initial conditions.

Curiously enough, as I write, a paper on "Sun Spots," by R. A. Proctor, in *Longman's Magazine* for April, is put before me, tending to prove the truth of what has been written. He traces the sun's energy and light to his power of attraction in drawing in material to form his body. It is shown above what those materials are. He follows Tyndall and Ball in assigning to matter the "promise and potency of light and heat." We have

shown how the light of the sun makes this earth warm. He tells us that Secchi said the luminous masses rush in upon the sun-spot region "violently, pell-mell." We have said that the purified gases are attracted instantaneously. He shows that sun-spots are "limited in space and time"—waxing and waning with a sort of rhythmic flow, but not uniform. We have shown that the supply of gases to the sun depends much on the fickle produce of the seasons. Mr. Proctor starts "a new theory of sun-spots" by eruption. With this we have nothing to do. We see nothing natural in it. But we thank him for enabling us to show that the sun-spots are in unison with the supply of luminous gases from space and worlds, which we believe do constitute the sunlight, and, if this is true, then the natural beginnings of this earth, the other planets, and asteroids were separate, nebulous gaseous masses gravitating in space, till they were in turn sensible to the light of the sun, and became the worlds of this solar system. "Nature and the Bible," by James Davis, gives clear evidence that "the sun is the great magnet of attraction," and derives his supplies from every orb in his constellation. His rays cannot be felt till "concentrated in a substance capable of absorbing and reflecting it." If this is a comprehensible sketch, if we have proposed a credible origin of sunlight and of earth, it will be possible to go on with the history of this world. All attempts to do so have hitherto failed, because we had no true data.

SECTION II.

SUNLIGHT AND COSMIC MATTER.

If the origin of sunlight and a sensitive nebulous mass in space has been understood, it is easy to comprehend the unity of cosmic material that exists between the sun and earth, as well as between all the planets of this solar system. The object now is to expand and explain the result of that unity, briefly given in the axiom, "This earth was born."[1] In other words, a nebulous, chaotic mass was converted into air, water, and solids by the action of sunlight on gases sensitive to that force.[2] There is no need to define the word sensitive; it is always before us in the air, water, and solids, in vegetation and animal. As it is in the children, so it is in the mother, guiding her innate gravitation into her yearly orbit round its centre of attraction, the sun. We must think on gravitation for a moment to enable us to see our way. The entire body of this earth moves in space with a wonderful rapidity. Space is said to be full of matter. Why is not heat produced by the rapid motion of one material through another? There are two ways of explaining the paradox. It is said that

[1] See Appendix C. [2] See Appendix O.

matter is of two natures, one bodiless and yielding, the other an unyielding body. We have an example of this as our unyielding bodies pass through the yielding air; and so the body, earth, is supposed to pass through space. The other explanation is that earth, as a body, is enclosed in the envelope of air, the limit of which is as intangible and subtle as the ether of space. We have evidence of this in the rarefying of our air, and it is generally allowed that the extremity of our atmosphere must be similar to that which it travels through without friction.[1] If this is the case—and there seems to be no reason against it—some of the refined gases must be perpetually passing into space, as waves on waves flow on, to meet the love of the sunlight. There is then a constant attraction and gravitation going on in the parts, while the innate gravitation of the whole body is held in guidance by the sensitive qualities of those parts to the sun.

Laplace told us as a fact that the action of attraction is instantaneous, so that we may now go on with the history of the birth.

As there are opaque nebulæ in space now, we may infer that they were always there, and that our sun and all his planets were once in that condition. We may also infer that there were many more nebulæ; that some have been absorbed by the sun, some by the planets, while some have formed the moons, the asteroids, and the rings. Under this process the nebula destined to

[1] *Nature*, 28th April 1887, gives a letter from S. A. Hill showing that the temperature of space is "about 30° Fahr. by one mode of calculation and about 18° Fahr. by another."

form the earth went on growing, as everything in nature does grow, till it reaches maturity. The condition of gases was gained when the chaotic mass first became sensitive to light. As the action of attraction on matter sensible to it is practically instantaneous, the innate gravitation of the nebula was at once converted into the revolution round its centre light, and thus every portion of the nebula came by degrees under its influence.

Evaporation began then, thousands of years may have passed before the thick vapours allowed the growing light to touch the waters, as the sunbeam does to-day; but, however long that process may have been, the cosmic work was going on. The gases were drawn up, their liquids fell back to form the water, solids were left to form the body, and solid particles fell back from the rising gases, to be deposited where the moving water pleased. Thus the lightened gases went on rising, their solid atoms were pressed out in the cold—the air became rarefied enough to meet the ether of space without friction, and the nucleus body went on growing, beneath its increasing envelope of water. In the act of losing the aerial and the liquid gases, the tangible condition of the nebula was changing. Two actions were going on together, which gave to the solid body the character it bears to-day. One portion of primeval rock is unstratified, the other is stratified. The two conditions prove their cause. All the solid material that rose in the evaporated gases, and became filtered from them by cold pressure, fell into the waters. These were necessarily in motion. They acted then as they do now. The particles falling on their surface were of all kinds, but the

waters separated them, the heavy atoms were lodged in their areas, and the light in their own, the lightest of each grade wafting into the confines of the next deposit. The whole of these stratified deposits were left with the grain horizontal, vertical, or at some angle between them, according to the force with which the water was moving, or to the quality of the sediment. In eddies and whirls this grain was left in every conceivable condition. The unstratified condition of primeval rocks is due to the fact that when the gases were withdrawn the unsensitive material was left to itself. As it hardened it solidified, as it grew it contracted under its own pressure, and under the pressure of the stratified sediments and water resting on it. This material was left in a quasi-homogeneous condition—that is, large areas were formed of like material. All of this was made with a grain; in the first instance generally vertical, but, as it was soft when first subjected to pressure and contraction, it became contorted and bent into many shapes, while the sedimental strata resting on it became conformable.

Under these influences of pressure and solidification there must have been a general contraction of the growing body; but as the sphere was smaller inside than outside, it followed that the contraction could not be equal. Dana told us that some areas of the Pacific Ocean bed had subsided more, but the general subsidence of the whole area, excepting the many islands, was about 10,000 feet. If we carry back this inevitable contraction to the time when the whole body was covered with water, it is evident that each local sinking of the bed made a general sinking of the water. There is no rea-

son to think that great areas sank at once; the action has been repeated over and over again in the same locality. We have evidence of land deserted by the sea within the memory of man, and of land sinking into the sea. We have sea-shells on mountains many thousand feet above the present sea-level, so that we have undoubted evidence in old strata on our highlands, in the fossil remains of varied epochs in high places, and in the certain subsidence of the general ocean bed, that the waters covered this earth at a level more than five miles above the present sea-level. The actual height of the first water-level is of no consequence to this part of our history; but, in treating of the birth of our trinity—air, water, and solids—it was necessary to explain how sunlight acted on the nebula to prepare it for the birth of a complete planet, which we call earth. This was accomplished when dry land appeared.

All that is written above was comprised in the brief sentence of the Psalmist—"He hath founded it upon the seas, and prepared it upon the floods." Man has misunderstood this sentence, and has misrepresented the Mosaic record—"Let the waters be gathered into one place, and let the dry land appear."

We have shown how the natural action of the materials, composed from gases, under the agency of light, formed our atmosphere, our waters, and the solids. We have shown how these solids contracted and subsided in their necessary gravitation, and the waters certainly subsided with the bed they rested on. As the entire solid body could not possibly sink into a smaller space than it occupied, it followed that the water sank into the lower

levels of its bed, and left ridges and islands all round the sphere to form the dry land. It is impossible to tell now in what locality dry land first appeared. The present highest land is in Asia, but we are told by geologists that all our mountains are lower than they were. Our early legends, our first history, all come from the East, so we may infer that the first dry land was there. There the human creature first thought that light was a God: they worshipped him in the morning as he rose, in his midday heat, and in the evening as he set. Nations in the East do so still; and here, with other creeds and other forms of religion, men still look upon an artificial light as the symbol of a living God. May we not, without destroying the conscience inculcated by our respective religious creeds, accept the old teaching, and comprehend that God is light; that He, supreme in the beginning and now, does and did draw to Himself all such lights as were sensitive to His love? that in that love He has, by His agent the sun, created the trinity of this earth—her air, water, and solids—and by the same agency the embryo came to perfection, and this earth was born. These have been sublime and divine conceptions. As God's light gathered strength from his luminous attractions he shed that light afar, and gathered to the care of their Creator all the planets of his solar system.

There had been a long brooding on the waters before earth was completed, and when dry land appeared a longer brooding before the more distant worlds were made, even if that is now done. As far as earth was concerned, its dry land made the sphere complete. The

light had kissed the waters, it had given life to the rolling wave; then it kissed the dry land; that absorbed the sunbeam; the reciprocity was there, as it is in all the children of our mother earth; the life was nourished by the sun, and, as the body earth grew on, that life increased and multiplied. This will be the subject of another chapter, but we have now shown how this sphere was gathered to his care, and how light went forth to fill God's kingdom with "bright worlds of love."[1]

[1] See Appendix C.

SECTION III.

VEGETATION.

Coeval with the appearance of dry land, grasses and herbs, with seed and fruit of their kind, began to grow. The vegetable kingdom had commenced on dry land. The third day of the Mosaic creation had ended. The sun had not shone, but his light was on the earth, and there "went up a mist from the earth, and watered the whole face of the ground." Commentators tell us that "God, by His creative power, brought the vegetables at first to perfection without seed and without the concurrence of the soil, sun, rain, or any other natural cause." Moist and solid material, with light and warmth, were there—all natural conditions. But where did the seed come from? The commentator wished to show that the power of God created vegetation without natural assistance; but in that attempt he brought discredit on theology, and put a false interpretation on plain words. Without denying the power of the Almighty to produce grass, herb, or creature, there had been a process going on that may have provided seeds for the new-formed land. Geologists have told us of old worlds broken up and re-forming over and over again. We have imagined the

nebula as holding in its gaseous mixtures all that was necessary for the construction of earth.[1] If, as supposed, this nebula had come together by the aggregation of smaller nebulæ or gaseous bodies that had escaped from the atmospheres of other worlds, then seed may have been conveyed within them.

We know that life germs are conveyed in the air, that it comes loaded with life invisible to our eye, till it begins to grow, and we know what care is taken to preserve life in its latent condition. When old forests are cut down or burnt, when the sun shines on the long-hidden soil, then plants unknown to that locality before begin to grow. We have been told that after the great fire in London in 1666 plants began to flourish in the ashes that had not grown in London before. Where saline springs exist marine plants begin to grow; where ponds and lakes dry up a new flower grows on the bed. In all these cases the growth seems to be spontaneous; but our Creator has this globe in His care, and has given to seeds, holding in them the light of life, faculties of long endurance, of bearing heat and cold, of burial out of sunlight, still preserving the inert germ, till natural conditions call that long sleeping life to light again. If the seeds for first vegetation reached this world from other worlds, we may continue to ask the question, How did the other worlds get them? without finding a satisfactory reply. So we are forced back to the old wisdom, God gave the seed. If He gave it once, He gave it in many instances. It was as easy

[1] *Athenæum*, 23d August 1884, shows that sea-water has no element "entirely unrepresented" in it.

for Him to make seed as it had been to make light and gases sensitive to it. The light of life, inert though it may have been, was given to seeds, with a full knowledge of what sunlight, air, moisture, and soil might effect in that minute globule. There were varied climates on the early surface of this sphere, with changing moistures and different soils; creation had begun, it had to go on; herbage was clothing the water bed, it was destined to cover the new-formed land.

There was a great object in commanding grass and herb to grow, to increase and multiply. It was to be useful to that life which was to come; it had to give its earthy materials to join and enrich the soil of the surface as it multiplied; it had to be buried sometimes alive and sometimes dead, and the gases of the dead had to go back to their centre, the sun, as contributions to that light which had brought their torpid life into existence, had clothed it with its temporary organic material, had lent it an existence endowed with love, with the privilege of reproduction. When we look upon the gorgeous and glorious flora of to-day, full of beauty, full of odour, all blooming in the sunlight; when we gaze upon the present artificial cultivation, with its edible herbs, grasses, and fruits; when we walk amongst our forest trees, and know them as hard, tough, brittle, and elastic, with gums, resins, oils, sweet and bitter liquids, with fibre for great cables or for tissue fabrics, it is hard to go back to the time when none of these grew on the earth; when the humble family, called cryptogama, began to send out seaweeds, mosses, fungi, and ferns, to breathe the murky atmosphere of those sunless days.

For the sun in his glory had not, as yet, penetrated the dense carbonic gases, though a hazy light gave warmth to the earth-material most sensitive to its force. Without laying down the dogma that mosses or lichens, with their 1200 species, were the first plants that grew on the first dry land, it is fair to point out that even now they seem to grow without seed, sun, soil, or moisture; they adhere to bare rocks, smooth trees, stones, planks, and old metal, in places where no rain or dew can reach them; they are mostly perennial, and seem to flourish by imbibing moisture with the air that passes through their open pores. Their many species, their various qualities, their endurance of heat and cold, qualify this family to have held the first place upon earth, and to have acquired, from that time to this, the most perfect form of vegetable fructification. We have in the beautiful agate stones perfect pictures of mosses, plants over which the cold liquid silica slowly ran, or gently trickled through, so softly, indeed, that the most delicate tendrils have been embedded as they grew in the transparent silicious mass. These mosses, or whatever vegetation first grew, gave the carbon colouring to the early slates and shales, to the limestone and sand formations, slowly growing on to the vast carboniferous system, beginning in the early palæozoic (old) epoch, and continuing into the mezozoic, or middle era of the vast sedimentary deposits.

Both these epochs are without date, but the fact is before us that vegetable matter to an unknown amount is buried beneath the surface of dry land. The whole of this grew on the surface as vegetation grows to-day. These buried forests tell us the history of vegetation

from the faint illegible pages of its early and scanty growth into the vast volumes of the middle carboniferous period. There these old forests rest, at varied depths, down to thousands of feet in two or three, up to forty or fifty, seams of coal. The microscope shows the structure of the plant, buried, pressed, and altered though it is, as plainly as a fresh cut slab of wood shows its fibres, its rings, and its knots. Many varieties of vegetable matter have thus been read in these old layers; but the book runs through the entire carboniferous system into the lignites and peat bogs of the cainozoic, or more recent epoch, and from that into the vegetation which now flourishes on land and in the sea, in all that loveliness which so charms our senses of smell and sight. There is a foot-note to the vast volume, which tells us plainly how some of these old vegetable areas were buried. There are now upon the surface of the earth great quantities of petrified trees; these were all washed down from the place where they grew to the place where we find them; they were buried beneath sands and silicious gravels till, by the constant percolation of liquid silica, those broken logs were slowly converted into stone. This shows that ancient forests were carried down by the rivers, to be deposited—high above present rivers—where the waters pleased. The next sentence tells how, on the British Island coasts, and in many other places, whole forest areas have sunk beneath the sea, to be partly or wholly buried under the triturated sands and silts. Of course only the surface relics of these sunken forests are known, but they tell the history of those old layers on layers covered over with ocean

deposits; and we know that, ever since vegetation first existed, the same system of subsidence has been going on, which explains in the most certain manner the causes of the faults, displacement, and fracturing of carboniferous strata.

These two actions of subsidence and removal of surface matter will be noticed in other sections. It must suffice here to say that, while material was constantly removed from land to sea by the streams, that trickled from the first dry land as they trickle from the tide-left sand or mud banks of to-day; while land fell bodily into the waters in greater or smaller fragments, the waters were themselves always sinking to a lower level by the natural and unavoidable gravitation and contraction of its bed. Waters were retiring, and the waste of dry land kept pace with it; the early estuaries filled up, tides and waves broke up the rocks, and comminuted all material intrusted to their care. The surface of dry land was extending by these causes, while the vegetable world kept spreading to its confines, enriching the soil with its decomposing matter, and sending out its seeds to perpetuate the existence of each family as it grew. We all know the faculties of seeds, not only to move away from their parent plant, but to fix themselves in the soil where they chance to fall. Many of us have seen the earth covered with springing vegetation in smaller or larger plots. We have found plants growing where they had not been before. We see the seeds flying in the air, hidden in their downy balloons; we see them thrown out by their elastic pods; they are gifted with prehensile burrs, hooks, and spears; they are carried

away by contact with passing creatures; they are eaten and dropped entire by bird and beast. But before these came upon the scene their own powers of locomotion, and the accidental removal by water or by wind, were sufficient to spread the plentiful seeds into all situations fitted for their growth.

Grasses are annual in their blades, perennial in their roots; the stems and leaves die after seeding, and enrich the soil, while their gases rise to fulfil their destiny. Mosses are generally perennial, and the fruit tree is always so. We may safely infer from the present condition of vegetation, that the first to grow on dry land were of both kinds, and that their initial characters have been passed on from that time to this. Climates, soils, waters may have changed outward appearances; but in the early days, before the sunbeam had kissed this earth, there must have been a sameness and a uniformity in vegetation; it was all engaged in breathing and embodying the thick gases of the primitive nebula, and qualifying the surface of the globe for that which was to come. The new coming of vegetation began on another day; the grass, the herb, and the fruit tree, with their seeds in themselves, marked a step in creation; the air had to be purified, the mist had to rise, the moisture had to be condensed, the rain had to fall, the soil had to be enriched during the long third epoch of creation. When all this was done, the sun lit up the earth by day, the moon and the stars lighted up the night.

Vegetation had inhaled the dense gases, they had been converted into wood, foliage, and seed flowers;

vegetation had covered all the dry land as it appeared, and sunk with it beneath the waves, to be buried with those gases which had come from the initial nebula beneath materials grown from the same source. We find those gases in our mines, ready to rush to the light, as exploding and destroying forces. In this knowledge of them we can comprehend the Divine system of giving life to vegetation, with the faculty of inhaling and imbibing in the gases, by root and leaf, those materials which build up their organic forms, all due to their sensitive quality acted on by sunlight.

We have reached the end of the fourth day or epoch of creation in the natural course of events, brought on by a sensitive gaseous body under the influence of light. This force had acted on the whole body, it was brought under the law of love; no part of it was hidden from the light, the different elements obeyed the Ruler, and ministered to His demands. By these the grasses, the herbs, and the fruit trees had sprung to life, each absorbing and retaining light in its own fashion. In doing this they had cleared the atmosphere of its dense gases, to form the solid bodies of the plants. They received the reward of their action, as the sunbeams shot through the broken canopy of cloud, to nestle in the fair perfumed calyx of each flower, to touch the anther, to ripen its pollen, to fan it with His breeze, or to wet it with His shower, and to drop that ripened seed upon the ready pistil, for the reproduction of its kind. The surface of earth grew warmer, the evaporated moisture did not always condense and return to dew; it rose higher, as it does now, to condense in the cold strata of upper air,

and to return as rain, as snow, or hail, to give fresh water to the surface earth.

Thus the whole sphere was slowly and surely brought into a condition approaching that around us to-day; every change was effected by law. Earth loved the sunlight, and, by their unity of action, the world mother was prepared to maintain the lives to be given by their God to-morrow, for the fourth day of creation had ended.

SECTION IV.

ANIMAL.

THE great vegetable kingdom commenced existence without the sunbeam; it was a dreary, misty, damp beginning, deriving the warmth necessary for its life from the light that, weak at first but stronger as it grew, forced its way through the dense atmosphere of the clearing chaos. When this was done, the sun-ray kissed his love, this earth; a more genial warmth began, and a new life issued from her bosom. There is still an undefined margin between the two kingdoms, so closely do certain animals resemble the vegetable. Linnæus defined the latter as growing and living; the former as growing, living, and feeling. The animal kingdom has been divided into mammalia, as suckling their young; aves, birds that lay eggs; amphibia, that live in or out of water; pisces, fish living in water; insecta, that fly, or crawl, or hop; vermes, creeping things without feet. Man is put in a class by himself, bimana, or two-handed. There are microscopical creatures, but from the lowest to the highest the structure is perfect. No creature shows an imperfect attempt at construction, and every one is fitted by physical force, and what we call instinct,

to provide for itself, and to maintain its kind by the privilege of reproduction. The margin between the two kingdoms is very narrow; vegetable and animal resemble one another in external character; the line between moving and stationary is very doubtful. Some say that life is spontaneous; others deny it, asserting that the life germ is in the air, and impregnates the material that is ready to receive it. In this difference of opinion there is one thing certain—life is! If there was an omnipotent Power capable of forming the sun, of preparing gases capable of absorbing his light, and of changing their character under his influence, then we need not doubt the capacity of that Creator to make the light of life, and adapt each individual in the multitude of creation to the place where it was created, as well as for the duty it was created for. Much has been said on these points; but, until a general spontaneous birth is proved, we prefer to assign all origin of organic structure to the God of light, acting by His agent the sun upon gaseous and material combinations, ready to form such body as was required to gather round the light of life.

We know that no animal begins to live till the germ is vivified by the mother warmth, external or internal, or by the sunlight acting direct or indirect; by the latter we mean by the warmth of fermentation,[1] by the former when the sun shines on earth or sand, in which the turtle, the bird, or the insect may have buried her eggs.

[1] Such as is produced by the decomposition and heat of the fruit or pulp round the seeds. Until this condition comes the seed is inert in cold pulp.

The first birth in the animal world is as undefined as the first vegetable. The Mosaic record says, "The moving creature that hath life, and fowl that may fly," then come "the great whales and every living creature that moveth, and every winged fowl," all before man. It is all indefinite; we need not suppose that any creature was created till climate, food, and drink were prepared for it. We may infer that first animal life came from the soil on land, from the water in the ocean, that there was no egg, sac, or other preparatory state for life, that it grew from an invisible germ into a microscopic body, gifted with an ephemeral life. If we may generalise for a moment, there is the annual death of much vegetation; the winds blow some of it into drifts and heaps; the waters carry off mosses, lichens, and the fallen leaf from the swollen brook, and the flooded river bank; these are left in quiet corners as small or great masses of vegetation. In both instances decomposition and fermentation ensue.

Few of us have looked upon an artificial or a natural mass of decomposing vegetation on a cold winter day without observing the warm moisture rising from the heating heap. That warmth is acting like the warmth of the womb, or like that of a bird on her egg, and the germs of life, that were left on leaf, or grass, or lichen, while alive, are progressing towards maturity in their decomposition. Few of us have looked on the same gatherings on a sunny day in spring without seeing clouds of insects rising from and playing in the tepid air above their nursery. Some of us have opened those decaying heaps in the heat of summer, to find it alive with

the worm kind. Reptiles, mice, rats, rabbits, and weasels have all been found thriving in the warmth of the dead vegetation, and when in autumn time these artificial heaps are carted and scattered over the fields, the multitude of initial and adult life that is destroyed or left to its fate is a curiosity, that has never been fully described. All through the early days of vegetation these decaying heaps were gathered by natural forces, as they are in the wild jungles of to-day. I have seen pyramids of leaf swept up by a whirlwind, and mounds of silt built up by water eddies. As the floods cease, and as the winds grow still, all such collections of matter become now, and did become in all past time, the nurseries for the young. Silken webs, and woven wombs, and gossamer sacs are to be found in these places to-day, all prepared by the parent. What prepared the egg or the cist in those days, when the only parent was the Creator? There are shallow waters in the seas and in the rivers. Fish swim up the streams for hundreds of miles against torrents, over waterfalls, through every difficulty, only to find the sandbed under the pure trickle of the fresh spring, where they were hatched, for the main purpose of depositing their own spawn, where the light must come, where the early insect larvæ are washed down, where the sun will give again light enough and food enough to their progeny, as he gave to them.

Denizens of the ocean flock to sandbanks to leave their spawn where the sun will glitter through the wave on the glistening silicated atoms, where warmth enough and food enough will be produced for their young ones, uncared for except by the Creator. There are fishes

that leave their spawn on the open sea, or that deposit it on marine vegetation; there are reptiles that drop it on the shallows of our ponds. There are some of many creatures that produce abundantly, while others have small families; these are the destructive, while the former are the supply. Who arranged all this, unless it were the Creator, who lent His sunlight to the shallow waters of the pond, and warmed the surface of the sea? Who found food for insect life, who gave the colour to the fly?

The birds of the air seek the high trees, the thick bushes, the grass tufts, the stone plains, the wet marshes, or the barren sands of the desert; they exhibit as much secrecy as they do ingenuity; they cherish their young, and will abstain from food till the little ones are fed. Who fed them, when as yet there was no father or mother of their own kind?

The beasts of the field wander over the plains, the hill slopes, the deep ravines, the thick jungles, and the wide prairies; they feed on the grasses and browse on the foliage. The creatures of supply breed plentifully; the consumers more sparingly. They suckle the young, they protect them; but who prepared the hiding-places, who made the food, who arranged the families, and who nursed the young or saved them from danger, when they were only cared for by the Creator?

There is but one answer to all these questions. They arise from universal facts, all brought about by one universal Supreme Ruler. There is no accident in life. Every creature that lives on land or in water is by its birthright qualified to occupy the place we find it in.

We have only to consider our own position to be aware of this great fact; we cannot live under water, we cannot fly in the air, we do not weave the silk cocoon or spin the spider's web, we cannot browse on foliage in the water or on land. We fill the place for which we were created, and we have been gifted with what is called reason, while a similar quality in the lower animals is called instinct. As far as they are concerned, it is as useful as reason is to us. There are animals of water, air, and dry land as gregarious as mankind. Herds, flocks, shoals, flights, tribes, hives, and nests have their laws as well as man; and, what is more, individuals as well as congregations evince a confidence in the care of a Creator, which in man, their immediate ruler, is sometimes lacking.

We may now return to the early history of the present multitude of life on earth. There is a difficulty as to the first life on land or in the water. The creatures of the ocean have left their remains low down in the Silurian system, to form great rock masses, in which zoophytes and foraminifera can still be detected. These rocks are sometimes called metamorphic; the only change is that they have been infiltrated and hardened by liquid silica. The former has been called the connecting link of vegetation, as it bears fair flowers on its moving stem. Minute shells have been found in ever decreasing quantities in the lower Laurentian rocks. All these creatures were buried in their natural element by materials composed of their own broken-up bodies, or by other triturated material. They were preserved by this process, but the life on dry land could not be buried so

quickly, neither were the bodies so capable of being preserved. Dying on the surface, they were liable to be dried and effaced by the sun, or to be broken up by wind or rain. Thus, even if there was life on dry land, the remains have not been preserved, while the arrangement of fossils has been thus made. (1.) The primary with none. (2.) The transition—Zoophytes and shells. (3.) The secondary—Plants and animals unlike present existence. (4.) Tertiary—Plants and animals unlike the present. (5.) Recent—Plants and animals like the present. It is not until we reach the triassic and neolitic systems of the middle epoch that dry land life begins to leave its traces behind. Nowhere do we find such formations as have been left by ocean life in its corals, its limestone, its marbles, its chalk, and its flints; all this belongs to another chapter, but we may say here that the remains of land animals have not made such structures as those of the land vegetable.

Certain groups of animal remains, broken bones, rubbed ribs, scattered teeth, and divided skeletons have been found in caves of limestone formation. Geologists have forgotten to tell us how one kind of cave was made in which there is no sign of water running through it after it was made. Animals of all sorts were plentiful; they were liable to fluctuations of climate as they are now. In dry seasons the herbivora seek the water-pools; the carnivora follow them. As water fails, they die. Ravines and river beds become strewed with carcases—some are eaten by birds and beasts; skeletons and bones are picked, gnawed, broken, and left to bleach on the sands. When seasons of drought end with a heavy rain-

fall, bones and carcasses, dry or fresh, are all washed down together. Similar material is liable to similar forces. Mountain torrents, deep ravines, the river beds, all give up their surface matter, to roll down together to the estuary. On this uneven surface the animal remains were heaped together. River soil, pebbles, and gravels formed their covering. When the tide flowed over the great heap, a lime deposit was left; this grew on till the mausoleum was completed. Stalagmite covered the decomposing heap; this slowly sunk by pressure, and the limestone cave was left above them, to be found thousands of years after its formation, with the remains in a curious state of preservation, only explained by their quasi-hermetical sealing up. Bones of similar animals have been found in gravel beds; some of these were coeval with the cave remains, but were not washed down with the large gatherings that formed the centre of this kind of cave. All heavy rainfalls washed down animal remains in those days, when beasts wandered through the woodlands undisturbed by the presence of man. As far as geologists have gone they have found nearly all the existing order of fauna in the oolitic system. The deposits are of a marine character, suggesting shallow shores and troubled estuaries. It is quite possible that much of the oolite and lias groups are made up of animal remains. Most of the creatures of these times died out during the cretaceous deposit, that is between the middle and more recent epoch of geological history. As we reach the last-named sedimental deposit we come upon great areas of chalk, interlined with flint, and smaller plots of chalk without flint. The latter may be

put down as chalk that was removed from one place to another, losing the flint in transit; but the white or pink chalk, the black, the blue, the yellow, and white flints, were all constituents of the organic bodies that formed these areas. It may be questioned whether the foraminifera actually lived over the site on which we find their remains; whether they did so or not those remains were subjected to much trituration, and were left as a white mud on the ocean bed exactly as the globigerina ooze was found by the *Challenger* on great areas all round the ocean bed. As all these minute creatures have silica in their bodies, it followed that, as the whole mass of the season was deposited together, the liquid silica, being the heaviest, sank through the soft season deposit to form nodules, with or without a nucleus, on the hardened chalk layer of the previous season. Thick deposits make large flints; thin deposits leave thin flints. Chalk seams may be found not an inch thick, and the flint below it as thin as fine glass.

The whole of this cretaceous system is full of the remains of life, chiefly marine; but, as we reach the tertiary system, the old flora and fauna are lost. The fossils, which marked a general distribution of similar life over wide areas, give place to those of confined areas, and point to a great separation of dry land from dry land about the end of the mesozoic or the beginning of the cainozoic epochs. After this breaking up fossil creatures are kept in their own lands. The kind may be the same, but the character varies with climate, water, soil, and food. The remains of strange reptiles, birds, and beasts have been found, but investigation has

been confined chiefly to temperate regions; the great tropical area, the original nursery of animal life, has scarcely been looked at.

As we rise through the varied groups of tertiary into the quaternary system we become involved in deposits of all present organisms; the entire upper covering of the dry land, the soil in which vegetation grows, on which the animal subsists, is nothing more than decomposed organic material, mixed up with meteoric dust and with triturated rocks, that were themselves at one time in bodies surrounding the light of life. The tidal shores, the sand deserts, the mountain tops, as covered with snow, and constantly shifting materials, may be exempted from the general rule. In the midst of all this vast mass of animal and vegetable material, we, here and there, in peat bogs, in old mud, in limestone formations, in gravel beds, find entire or mutilated skeletons of creatures that do not now live in those localities. These mark the zoological history on the geological page. The end of old races is marked on the margin of the new. This subject will be touched on again. As soundings by the *Challenger* found deposits of one sort merging into those near them, so the deposits of organic matter merge into one another, and it is hard to say which is vegetable or which is animal. Every creature that lives now, or that has ever lived, on dry land or in water, has contributed, and will contribute to the surface matter of this earth. These sedimentary deposits, if put together "in the order in which they were deposited, would form a mass at least ten or twelve miles thick" (Prof. Geikie, "Geological Primer," p. 66).

As far as the animal deposits go, the whole work has been done since the sun began to shine, since the moon and the stars gave their lights to earth; but the time of its commencement is unknown, though marked as the great event crowning the sixth day of creation. We assign all this vast and wondrous formation to the direct and indirect action of sunlight, as the universal agent of the Creator.

SECTION V.

DENUDATION AND DEGRADATION.

As soon as dry land appeared the action of drainage began, similar to that which takes place on the tidal banks and shores to-day. In this work all that could be moved from the surface was carried to the sea from the new dry land. There was another action going on in those days more persistent than now, which aided in sending the solid materials into the water; and it is necessary for the reader that the two actions to be alluded to in this letter should be clearly defined. The wearing away and removal of surface earth by natural causes is called denudation. The natural subsidence of the surface by normal gravitation or consolidation is called degradation. These will be the subjects before us now, as part causes for the present aspect of the surface earth; while the accidental mining and sapping by fire and water, as both contributing to that effect, will be reserved for another chapter on earthquakes and volcanoes.

When the first dry land appeared, the action of water on matter was precisely similar to what it is now; but there was some difference in the material to be acted on. There was the original formation left by the abstraction

of the aerial and liquid gases. This may be considered as a firm, quasi-homogeneous mass. Over this and mixed with it was the meteoric dust, always falling back to the body from the evaporating gases, as they became purified by the cold of the upper atmosphere. On this formation the early waters rested to produce their vegetations and animals. Their remains were at the disposal of wind and water from the moment of death. Then, as now, light material was moved by waves, tides, and ocean currents on to those higher undulations which had been constructed by themselves; therefore, the surface of the first dry land was covered with the dusts of what had lived beneath the sea, and the germs of land life may have commenced from those of the ocean.

This land was now a barrier to the waters. They perpetually brought fresh material from their own supplies, while the surface drainage or natural denudation was removing materials from the gentle or abrupt slopes to meet and amalgamate with those of the seas. Those who have watched their own tidal shores have seen and understood how the dry land is continually giving matter to the waters, and how they are continually throwing up matter on the land. The area of land was, therefore, constantly increasing under the laws of gravitation and of denudation; but the law of degradation must be looked at before we can see how the surface earth was affected by the action of these two bylaws of universal gravitation. We have already pointed out how the solids of earth were left by the withdrawal of gases to the sunlight. In whatever form these residues came together, there must have been portions without complete support.

As the gases escaped, and as those portions grew heavier by the deposit of fresh matter on them, as well as by the general increase of water, it followed that the weakest areas subsided, while those with firmer foundations remained as they were. Physical science tells us that this earth is now practically solid; the same school allows that it was once in a nebulous condition. In the change from one state to the other, there must have been some slow and some rapid acts of degradation. Of whatever kind they were, a contraction of the body must have taken place, and convulsions of the surface necessarily ensued. We have direct evidence in our sunken forests, in our coal seams all over the dry lands, in the coral structures all round the ocean, that these degradations have been universal. The utmost limit of coal depth has not yet been reached; but Professor Dana estimated the contraction of the Pacific Ocean bed at about 10,000 feet, and mountain height coincided. We know that the present mountain tops were once under water; all of these were once from two to four miles higher than they now are. We have no measure of subsidence before forests became coal, or before coral islands began to grow; we do not know when the coral zoophytes or the buried vegetation began to live; but, as we trace water-laid stratifications on our highest mountains, as we find marine fossils and old raised wave-made tidal banks high up on the dry land at intervals all round the world, it may be safely inferred that this normal degradation began before life existed; that the highest level of the solid earth was deposited before that time; that its surface was broken and rent

by those primeval convulsions, and the contraction of the whole body slowly but surely took the water away from those highlands, which have from that time to this contributed solid materials to build up all those great continents, that spread their plains, valleys, and the little hills from their first dry lands, on which the wave broke in unrecorded time, to that shore three or four thousand miles away washed by the ocean tides to-day. In all this degradation and denudation have ever worked together under one ruling law or force of sunlight. This took up the gases and left the solids to the universal law of gravitation down below, the liquids to the same law above; both together forming the body on which its own members are perpetually at work. The surface earth could not be as it is without this ruling force. Old philosophers felt it when they said "God is light." Mountain heights and the sea level are the great proofs of His power and of the actions above recorded.

In the face of these facts Professor Geikie tells us in his "Geological Primer" of 1876, edited by three other noted teachers of cosmic actions, "Strange as it may seem to you, it is nevertheless true that it is the land which rises, not the sea which sinks." So taught the honest Sir Charles Lyell for a long lifetime. Towards the end of it he found a sunken forest buried beneath ocean deposits. On this he remarks, as a new discovery ("Life of Sir C. Lyell," vol. ii., p. 440), this "must unquestionably have sunk down." At p. 449 he finds sea fossils 1200 or 1400 feet high, and exclaims, "Is not this a surprising fact that such a great body of land has been uplifted in past pliocene times?" But it was not

a fact in any time, and Sir Charles began to feel it, for in August 1874, six months before his death, he wrote, p. 453, "I have been lately thinking that we may be under a great delusion when we find proofs of upheaval in ascribing to the movement an almost indefinite lateral extension, whereas all the evidence which we have in regard to the modern effects of earthquakes runs quite in the contrary direction." The great geologist had been brought up in the Plutonic school, and like many other believers in the nebular hypothesis, he held that all possible and impossible actions were due to the expanding force of a heat which never existed except in the ideal of Laplace. He thought that one nebulous mass occupied all the space now traversed by the planets of our solar system, that it had swollen to that size under intense heat, but where that heat came from he did not know; and our most astute modern physicist, Professor James Croll, after going through all the ideas on the subject, without finding heat enough for the calculated expenditure, tells us at page 354, "Climate and Time," "We are further obliged to admit that the mass must have received its heat from some source or other." Mr. Croll and many others have forgotten, in their desire to maintain the great principle of their school, that an intangible nebulous mass does not acquire heat while gravitating through intangible space; and yet it is to this gravitation chiefly that he owes his ideal heat of the sun for "less than 100 millions of years."[1] Having thus allowed professional geologists to acknowledge their own ignorance of cosmic conditions con-

[1] "20,237,500 years."

nected with our subject, Mr. Croll leads us back to the point by the unfortunate limit to the sun's age. He allows that geologists require a longer time for earth denudation than 100 millions of years; then he lays down a dogma, "methods of measuring subaerial denudation, when properly interpreted, are in perfect accord with the deductions of physical science." Then he thinks that "perhaps there are now few who have fairly considered the question who will refuse to admit that 100,000,000 of years are amply sufficient to comprise the whole geological history of our globe" (p. 355). On turning to chapter xx. we read: "Knowing the quantity of sediment transported by a river annually, and the area of its drainage, we have the means of determining the rate at which the surface of this area is being lowered by subaerial denudation." Mr. Croll took his data of material from papers by Messrs. Humphreys and Abbot, and found the rate of denudation on the Mississippi watershed area of "1,244,000 square miles to be about one foot in 6000 years" (p. 330). Other geologists have accepted this measure of matter as the real value of denudation. They all forget the fine material that stops in the river bed, just as dust and snowdrifts stop at each obstruction. The unbroken boulders in the mountain tributaries were not thought of, and curiously enough, the geographical area has been adopted for a calculation, in which the physiographical area was required, before any approach to accuracy of denudation measurements from the material conveyed by rivers could be arrived at.

At p. 337 Mr. Croll tells us that the above rate of

subaerial denudation is "about 1740 times as much as that removed by the sea."

About the same time as Mr. Croll was giving these physical instructions to the world, much practical geology was going on in the regions about the Mississippi watershed. Powell, in his "Geology of the Uinta Mountains," tells us there are no means of determining time for denudation. He gives, however, an account of three and a half miles of earth material having been removed. This by subaerial work would occupy 110,880,000 years; then he gives 10,000 feet of quartz rock denuded under water. By Mr. Croll's figures this work gives us 104,400,000,000 years. The time occupied in constructing these masses may be safely left to those who have solved such vast problems as the age of sun and earth, and who have satisfied themselves as to the amount denuded without any knowledge of the area alluded to. Mr Croll tried this question, but, as his limit of age was so brief, he did not like the computed maximum depth of stratified formations, because the 72,000 feet demanded 1,036,800,000 years for their construction, so he finished his chapter, and left the question open.

We resume now the simple history of natural surface denudation where we left it, that is, parts of the body were constantly at work on other parts. The air, as the outer envelope, moved with varying force. The evaporated moisture condensed at varied heights, and fell with varying forces and on varying forms. The solid body at present is constructed of all the dusts of organic bodies to the depth of some say, thirty miles; some say, 72,000 feet, or nearly fourteen miles. Accuracy is im-

possible, but we know that this mass is mixed with decomposed and altered material. In the soundings by the *Challenger* we know that the character of deposits changed frequently; similar changes are found on dry land. On all this varied material the varying forces of wind and water, heat and cold, are always at work. Material is set free, and is carried away to be used elsewhere for new formations. Beneath these deposited materials the so-called primeval rocks are found at varied depths, and sometimes on our mountain tops. Any organic matter that may have been there has been moved away. In many instances these primeval rocks are broken and faulted. These conditions tell of subterranean degradation while the sea-level was higher. Thus two actions helped one another. What was taken from the surface put a weight on another area; subterranean sinking took place, the surface was shaken, fractured, and sunk. This belongs to earthquake history; but these surface actions made the area on which they happened more liable to subaerial denudation. The whole of this work is done by law; but as the factors are always changing, and as the highlands have been left farther and farther from the sea, making the rivers larger and longer, it is simply impossible to form rules for amount of denudation, for quantity of removal by wind or water, or to say how much of that which is denuded may reach the sea. All we know is that some material from the land must have reached the waters from the time when dry land began to be, that this action has continued ever since, and must continue as long as sunlight acts directly on the air, the water, and

indirectly on the solids of the earth. Thus denudation must continue; the mountain tops, the precipices, the rugged ravines, the deepest caverns, and the most extensive plains, must all contribute their surface atoms to the waters, and all must help to make those waters shallow. Such is the result of surface denudation. Some of the latest convulsions of the surface earth may be due to natural inherent gravitation, but as other causes intervene, they will all be considered together. All we know now is that these subsidings and degradations began when this solid sphere was young, even before there was dry land. If they had not taken place dry land could not have been; for there is not now, and never has been, any known inherent force within the body to force up area after area. The sinking of the sea level was dependent on that natural gravitation, which must have followed on the abstraction of the gases from the centre of the nebulæ by the certain action of the light. We have evidence in the coral islands, in our coal seams, abrupt cliffs, and split mountains, that this work has never ceased, but we can give no date to the subsiding of the latest forest, now a coal seam, or to the sinking of the last segment of a coral island. There they are in the ocean 2000 fathoms deep down on the varied strata of the Silurian systems; and there are our coal seams half a mile below our feet, remnants of forests that grew upon the surface and flowered in the sunlight on plains, or in valleys, or on hill-sides in soil prepared by decomposition and denudation, and placed where we find them by the inevitable law of gravitation.

SECTION VI.

RIVERS AND MOUNTAINS.

THESE features of the dry land surface are very near relations. Rivers began before there were mountains, but both owe their existence to sunlight. The wondrous love of earth gases for that luminary withdrew their chaotic mixtures from the nebulous mass, and, as before shown, all that could become solid did so, and were left to meet the light of heaven face to face for the purpose of fulfilling the destiny of a planet. It has been shown how and why the dry land appeared, and how the liquids naturally drained from it. This drainage formed the first streams, and showed how the natural deposits poured out their libations as repayments to the water body for its refreshing loans. In those early days the light had scarcely warmed the vapours of earth, but we gather from this fact the condition of evaporation. At the present time the liquid gases are condensed into dew, when the Fahrenheit thermometer stands at 50 to 53 degrees. There is no reason for thinking that any change has ever taken place in this phenomenon, and we may assume this pleasant temperature as that which generally existed before the sun developed the full glory of his

light. In this condition evaporation was copious and the dewfall great. The land on which it fell was already saturated with moisture by the slow retiring sea; it would hold but little more, and therefore the greater part of the heavy dewfalls flowed down the little drainage rills, and took some solids on to the sea.

Then, as now, the constructing forces of wind and water came chiefly from one direction; the formation of solid areas acquired a character from this action; the face on which the force fell was most abrupt. The face over which the force retired, or where it did not act, was more shelving. The one is called the tail, the other the crag. The early drainage was affected by this formation; from the crag the water fell off suddenly through narrow gorges; from the tail it drained chiefly through the bed, coming out at flood tide low-water line, or it ran meandering through little channels to the sea; every channel being a type of water-worn river courses of to-day, each taking its character from the nature of the surface material. Some of us have followed a river from source to estuary. We have seen it in flood and in drought, clear as crystal or thick with mud, now flowing down a rock incline, now rippling over a boulder, pebble, or gravel bed, with a wide channel; now contracting its stream, and slowly filling its depths through a long level of clays and soils, then spreading into a sandy reach, where the river had once met the sea, then twisting and winding through low hills, once banks formed below water, sculptured into their present rough forms by denudation, filling the low lands with their débris, and offering, as the ocean went away, an easy labour for the

growing river to carve out a broader and a deeper channel, forming a wide estuary, where tides and bitter waves met the fresh water with its ever varying loads, all to be tossed, and rolled, and beaten, till fresh organic dusts, vegetable and animal, were mixed in solution with lime and flint, all to be deposited in separate places by the even-handed discriminating powers of the troubled sea.

Some of us may have been on the craggy side of a mountain during a storm. We may have seen the slopes, the little channels, and larger ravines pouring their contributions into a rocky gorge. We may have seen the yellow flood roll on, carrying broken trees and struggling creatures on the curling waves, to be hurled to destruction over a fall hundreds of feet high, all to be mixed up with triturated rocks, muds, and clays, to be tossed by angry billows to the sea, over a bar of sands gathered by the fighting waters, and filling the locality with a scene of cones and hollows of tumult and discord in which no boat could live, and once seen can never be forgotten. Some of us, again, have followed the upward course of rivers from the estuary in the summer time, when little rain is falling. Up we went through vine-yard-covered hills and corn-laden plains, through rock defiles and foaming cataracts, with the snow-foam flakes flying over all, till boat and tow rope could avail no more. Then came the climb up goatherd tracks, with the white river glistening in its rough bed, now below us, now rolling over a precipice hundreds of feet above us. Up, up we go, thin snow is melting beneath our feet, little water-trickles wander through the grass plots, or roll down little steeps, and then a black, blue mass

before us, crowned with trickling snow, and draped with icicles, gave out a haze of prismatic colour, hanging over a great volume of water, rushing from the melting glacier and surrounding snow. There was matter in those coloured flitting clouds of haze, matter in the foam flakes, matter in the waterfall, matter in the flood, all down that river; matter in solution and in suspension, with stones and rocks rolling down, triturated into sand, pounded into mud, rubbed into boulders, pebbles, and many-coloured gravels, every atom taken from the surface of that watershed. Besides all that is gone down with the flood, great rock fragments are slowly but surely travelling down upon the glacier, in long lines near each side of the valley, with scattered masses here and there over the wide face, these telling of lofty precipices and flying leaps, the others of fragments gathered from each bank by the pressure of the passing ice; every fragment doomed to reach the glacier limit, and to add their masses to the growing morain. This is a construction of varied size with gneiss, granite, slates, and serpentine, limestones, marble, schists, and quartzites, shales, many-coloured sandstones and conglomerates; the last telling of old denudations and construction similar to that we have just looked at, all gathered from highlands now gone, but brought down with the other rocks split off from the highlands still here.

Thus material has been moved away by every stream that ever issued from glacier, from natural springs on mountain sides, from valley slopes, or from lowland fens and bogs. In this removal of matter the forces are for ever changing; glacier rivers swell in summer time,

highland sources increase accidentally with rain, lowland sources are most equable, mountain torrents come and go, sometimes when least expected.

An Indian village went to a mountain gorge to catch fish in a well-known pool; a bedridden man alone was left behind, for men, women, and children would return next day with food in plenty. The pool was reached, the milk bush was thrown in; the fish floated on the surface of the quiet water; they were caught, cooked, and eaten; the evening had come, and twenty-six human beings slept among the rocks of a mountain torrent bed. Fifteen miles away a thunderstorm was raging on its watershed; madly rolled the wave along; the gorge was filled, and mangled human bodies down the vale told next morning of the water power.

There are two errors in natural history connected with our subject that may be briefly explained here. (1.) In chalk and lime formations the surface sometimes sinks, and little or large hollows are made. As water gathers in these it finds entrance, and in time forms a "swallow-hole;" this grows, and a stream of water issues from a crevice many miles away. As that stream passed through the rocks, it met obstructions, its force could not subside, while supplies came in; hollow places, galleries, and caves were formed, and in these places materials rested that did not float on the surface of the water. The hollow of the swallow-hole formed a trap, there was grass on the shelving sides for grazing beasts; and they, alive or dead, were baits for the carnivorous, especially in times of drought, for they are usually moist and green. There is always an inclination to move down instead of

up. These swallow-holes are very steep sometimes. The water running down is a temptation or a force in the same direction. Thus beasts of many kinds and some birds were tempted into the traps, or were washed down streams that ran underground, to be lodged as a whole carcass, or as a broken-up skeleton, with rubbed ribs and notched bones, all done in their rough journey, and not carried in there by the hyæna, as supposed by so many who have written on these bone caves. In whatever condition these subterranean passages may be now, and however practicable to man, they were not so to the creatures that owned the bones. They did not walk through a roaring torrent up hill in the dark. Wild creatures do not die in dens, if an open river-side or a soft marsh is available. Hyænas do not drag the head of a rhinoceros or the body of a snipe from where they find them into a cave; it is fashionable with these beasts now to dine on the carcass where they find it, and, if they do so now, while man is likely to disturb them, we may safely infer that they did much the same before man asserted his dominion in these regions.[1]

(2.) This also has become a prominent error with natural historians and geologists, originating in the insular character of their inquiries. It is asserted that rocks are scratched, grooved, and polished by ice friction. Therefore when buried rocks are exhumed, and found to have scratches and grooves upon their surface, they have been taken as evidence of a glacial epoch that ended about "240,000 years" ago (Croll). I have examined

[1] See Appendix A.

many of these places, and take a type in Lucerne. The polishing was all done by running water; the small scratches and the larger grooves were all done first by sand and water; then as they increased in size gravel and pebbles made them into grooves. Some of these follow bends in the rock, which ice could not have done. It has also been said that several small pot-holes on this site were formed by water running under the ice, and working stones round and round. If ice had been there these holes could never have been formed; they never are, unless on a declivity, where water assumes a tremendous force, and twirls sand, gravels, pebbles, and eventually great boulders, in these holes, which I have seen of vast size, attended by scratches, grooves, and polishing, all of modern date, where ice is almost unknown on Indian rivers.

These two subjects were scarcely necessary to our history, but both illustrate the work of rivers, and tell us that in all time running water moved matter from one place to drop it in another, and had the power, with the aid of that material, to wear away the hardest impediments on its course. There is no river without impediments. We see them in the soft mudbanks of our tidal shores. The Colorado has worked through many miles of early obstructions; it has worn them down through all the deposited sedimentary matter till its waters are now busy eating away the granitic bed of the azoic epoch thousands of feet below the surface of that cainozoic or recent deposit, over which those rushing torrents first began to flow. The same thing has taken place with all mountain torrents. Vast gorges

have been cut away at varied levels; long eras have been occupied in each work. All of those obstructions were formed below the sea, and, if the sea had not subsided, those varied levels of river work could never have existed. No geologist will venture to assert that, in the imaginary local and patchwork upheavals that they advocate, an upheaval could have extended more than 4000 miles, including estuary plains, little hills, and great mountains, rock obstructions here, and mud depths there. No geologist can venture to assert that submerged forests and deep coal seams, coral islands and historic sea-bed subsidings, were the only sinkings that ever took place. We have old river beds far below the surface to prove the contrary, and it is by the consequent sinking of the sea level that our present rivers have held the same channels so long, leaving behind old estuaries, old sea-made sands, and marine fossils, to tell of ocean's presence more than 4000 miles of river course distant from the present sea estuaries, and some miles above the present sea level. No action but that of a gradual subsidence could have obtained the results before us.[1] Present mountains send down their waters to the sea, all carrying matter with them. Those mountains were once from two to four miles higher than they now are, and all that material has gone down the flood of time to construct the lands we live upon. In this construction the entire sedimental deposits came from the highland to the sea. Waves and tides left them where we find them, and when we look at the extent of land

[1] Appendix O.

left by the sea, all built up from their own higher solids, we can no longer wonder that the once ocean-formed, gently-undulating plateaus, should have been worn away into the present mountain forms, that the whole of their material should be now beneath our feet, or that the rivers should be still at work, carrying mountain tops and surface matter to the sea.

In conclusion, river sources are sometimes difficult to reach, and mountain tops are still more so, but in these days of easy locomotion any one may look at the surface drainage from a tidal shore, and find there a type of the water leaving the first dry land of this world. Few, however, have the chance of watching the result of that water-flow. They cannot see the forests growing on the increasing slopes, contributing their yearly foliage, the spoils of the tempest, or the ruin of the earthquake to the troubled waters, but they can hear of all that old surface ruin far down the course of the Mississippi, where the waters play with those soft deposits, where the main channel may be here to-day and twenty miles off to-morrow; where towns built upon the banks are now miles inland, or all washed away; where great islands are constructed, and where river barriers are formed in one flood to be washed away by another; where the wild floods roll over wide plains, to give a sea of waters for a time—all gathered into this vast river from its fifty-four great tributaries, on which steamboats ply, and from its hundreds of smaller rivers, most of which participate in the commerce of this new world. There it is with the largest known watershed, but the Amazon is the larger river, collected from a more copious rainfall

area. Men have ventured to calculate the age of some formations on the Northern river. The mud makes the land grow, but, if the river once met the sea at Baton Rouge, then the land from thence to the sea, 200 miles in length, at about 1760 feet in 200 years, took 120,000 years in making. If the same rule could apply to the entire length of the Mississippi, say 4000 miles, we get 2,400,000 years as the time occupied in constructing that vast valley equal in area to all Europe. But, with varying material acted on by varying forces, no rule can be made. All we know is that rain falls, rivers fill, mountains are washed away, all by the direct or indirect action of sunlight.

SECTION VII.

EARTHQUAKES AND VOLCANOES.

THESE two phenomena are as closely related to each other as rivers and mountains; but as rivers may exist without mountains, so earthquakes may take place in regions where there is nothing volcanic or heating in the rocks or in the water. Under the natural system of unforeseen actions in and on this sphere, now before us, it is necessary to divide the motions of the solid body into their different characters. The omission to do this has led to much miscomprehension with the teachers and the taught. A few words will show us how far modern schools go out of the way, and how readily a sensational and incomprehensible theory, when inculcated under the name of science, becomes fashionable. The *Quarterly Review* has been the medium for papers on cosmic action for some years. It is a truth-loving periodical; therefore speculative and unfounded theories published in its pages carry belief with them. In the number for January 1869, we were told the most popular notion regarding earthquakes "is the hypothesis of contraction of the mass of the globe by radiation of heat into space." Then we were told dogmatically, "This earth was once an

igneous globe. . . . There came to be formed a solid shell" . . . with a "crackling and crumbling," for in those days "there were earthquakes on the grandest scale." We shall see presently that this effect may be produced without fire; but learned authorities differ in a few years, as we shall see as we go on. On the 5th October 1872, the *Spectator* wrote—"It is now generally supposed that, if the earth really has a molten nucleus, the solid crust must nevertheless be far too thick to be in any way disturbed by changes affecting the liquid matter beneath." The *Spectator* does not think the molten matter "could maintain its heat for ages." Then in considering the volcanic theory of Mr. R. Mallet it is allowed "that the hotter internal portion must contract faster than the relatively cool crust," and so "the shrinking of the crust is competent to occasion all the known phenomena of volcanic action." Mr. Sterry Hunt tells us that a "plastic zone of sedimentary material" is enough to explain all these phenomena ("Chemical and Geological Essays," p. 56). Then it is not too thick to be disturbed by action from below, whether as simple earthquake or complicated by volcanic eruption. By putting aside all these guesses, and by arranging these phenomena into classes, it seems possible to arrive not only at the causes for each class, but at a general law for volcanoes and earthquakes.

The classes are—1st, earthquake by degradation; 2d, by subterranean denudation from other causes; 3d, earthquakes with hot mud, hot water, and volcanic eruption; 4th, without any heat; 5th, landslips and avalanches. Under the system laid down in sections 5 and 6 it will be

seen that "after the earthquake a fire"—1 Kings xiv. 12—was taken from nature.

The first class or degradation earthquakes give us action on "the grandest scale;" they began before the sun shone upon the earth; there was no "igneous globe," or "radiation of heat into space," but contraction began under the universal law of gravitation, and goes on still, wherever there is no support for the superstructure of our earth, or, in other words, when natural laws and actions aid the progress of gravitation. In looking into the character of normal degradation, we find it consists of patchwork, done at intervals. The partial sinking of coral islands allowed hundreds of years to pass away before another sinking took place. Our forests had time to grow on the same sites over and over again. They sank into the sea, and were buried by water deposits; the sea sank, and the surface of the forest grave was dry land again. This action, says Geikie, "went on at intervals . . . through vast periods of time;" for "the coalfields are many thousands of feet thick, and must have needed long ages for their formation."

In all of these sinkings circumstances have taken place which have not been noticed, though late earthquakes must have been influenced by them, if, as we suppose, the effects of normal degradation are still acting on earth's surface. When a furrow is drawn by a plough, or a trench is dug by a spade, the soil removed occupies more space for a time. So it is with subsidence, the strata are partly broken up and occupy more space than before. In this condition the broken rocks offer a tem-

porary support to strata above them, and it is not until these broken masses become solidified again by natural gravitation that the superstructure is left entirely without support. As the radius of this earth is 4000 miles, and as the area decreases, it follows that a subsidence taking place to-day at 3000 miles distant, vertical to Ireland, may not be felt anywhere on the surface of earth for thousands of years, and then an earthquake might be felt from that subsidence at the Antipodes. The broken-down strata solidify in varied conditions, and hence future subsidings may take place in any direction. When a degradation earthquake takes place in primeval rock there is no volcanic action of any sort on that site, because there is no combustible material there; but when the action of this quake rises into strata, where sunlight-born materials are gathered together, then hot springs and mud ejections may take place; and, if all the demands on alkalis, water, or other combustible materials are complied with, a volcanic eruption will ensue. There is analogy to this in our domestic fires; the poker breaks the coal, and fresh gases escape in flames; the fall of material in an earthquake breaks up material, liberates gases, and eruptions ensue. These degradation subsidences must have began before there was dry land, for there was no other cause for its appearance. Soon after that event happened we come on another kind of quake.

Second. Subterranean denudation from other causes. After the normal unavoidable gravitation there is no universal action in this earth more certain than denudation below the surface by water and by fire. The first

consequence of either action is undermining, and thus taking away the supports of upper strata. The fire action implies two things — first, material to burn; second, a cause for ignition. These causes are chemical action with water and alkalis, and mechanical action by pressure or friction. When supports are removed from subterranean strata they must fall in sooner or later. Hence, earthquakes are common in regions where water or fire have worked, for both agents may come again; and, as quakes set free the combustible ingredients, a volcano comes if they are plentiful. Heat expands water and gases, giving out stupendous forces. The scientific report of the Java earthquake-volcano told us that there were no streams of lava. We may therefore infer that the fire found no silicious rocks to melt. Erupted ashes were carried 764 miles. Smoke and steam were said to rise to a height of twelve miles. This estimate is not safe; perhaps it was made in reference to the sunrise and sunset phenomena of the last half of 1883, attributed by some to the dust thrown up from Krakatoa; a very volcanic idea, but the phenomenon of bright after-glow began first. The more solid matter was thrown to 4¼ miles. The sea wave, caused by this quake, rolled at great speed all across the Indian Ocean. The air wave of the concussion encircled the earth more than three times "with the rapidity of sound." The material thrown up was "pumice, bitumen, and obsidian." If the latter is a volcanic glass and not a crystal, it gave evidence of former heat; if it is a water-formed crystal, then the eruption was not a very hot one. Professor Bonney was "disappointed to find that obsidian cannot be made

by fusion" (*Northern Whig*—Letter, 18th August 1885). Bitumen gave evidence of previously unburnt vegetable matter, and pumice, with its silky fibres, tells of a burnt-up product of silicated material. All the erupted matter proved that the fire originated in sedimentary deposits, that they were loaded with gases, and that water was there. The quake was caused by sapping and mining, and was, therefore, under the law of subterranean denudation, in default of any evidence of degradation.

These quakes frequently recur in the same spot, because the sapping forces are always at work till they die out; thus we have instances of quakes in volcanic regions without any igneous action, simply for the reason that the combustible material has been all used, just as the fire goes out. If, as is supposed by theorists, these fires came from the centre of an "igneous globe," or from a hot plastic magma, the eruptions would never cease, neither would they be spasmodic as they now are, while dependent on the liberation of igneous matter by subterranean gravitation.[1]

The third class of quakes are those that eject mud, water, and other matter. Skaptarjolcul, in Iceland, is a sample; in 1783 it threw up two rivers of lava over 40 miles long, with a breadth of about 19 miles, and a depth of some 600 feet. All this was, before being melted, a silicated rock; the silicious components were forced up as molten slag or lava. Similar cases have

[1] Since the above was written my view is corroborated by Sir W. Dawson, who told the British Association in 1886 that the theory of hot globe must be given up and hot magma substituted. For this, however, there is no foundation.

occurred in many volcanoes, and in every case the superstructure was undermined in proportion to the material thrown up. Mud is often ejected from volcanoes. Pompeii was buried in dust and ashes. In many instances these fine materials are cast on the surface of lakes and seas unexpectedly, burying living plants and animals. In all recorded volcanic action steam has been ejected from the craters in great volumes. These ejections prove the presence of organic matter around the source of heat. The lava may, indeed, come from primeval rock, but we have no evidence of this impermeable rock having been continually sapped; there is no evidence of any combustible matter in it.

The theory of an increasing heat as we descend in the earth, as said to be shown in mines and wells, is too ridiculous to discuss fully. Man has not delved one mile into his 14 or 30 of sedimental deposits, and in every foot of all that unknown distance there may be dusts of organisms, containing gases that may be heated by pressure, or alkalies that may give chemical heat. The latter is sufficiently proved by hot water springs round the world, all giving evidence of local heating causes, and both are proved negatively by the comparative coldness of salt mines, which have no igneous ingredients, and very little gas in their structures. Volcanoes and earthquakes are near relations, and always aid each other in their actions.

The fourth class holds all those quakes that give out no heat. One was recorded by the *Athenæum* of 9th October 1869, at Murwut, East India. "The underground moisture is commonly found two feet below the

surface." An earthquake took place on this area, when the water from below rose to about six inches of the surface all over the affected area. As the surface sand was dry it had no adhesion, and sank into the moisture. This sinking caused the quake. We see a sample of this action in our footprints when walking on drying sand. In 1871 a quake took place at Bathung, China, when "black, fœtid water spouted up," or, in other words, the surface earth fell into the water and forced it up ("Biography of Dust," p. 159). The great quakes in Calabria, 1783–86, were attended with upbursts of water and sand. 215 lakes and morasses were formed by the subsidence of the surface. In 1871 an earthquake was reported in the Lake districts. On the 25th of March the *Kendal Mercury* published a letter explaining the phenomenon. "We had a dry summer last year. Our springs sank low. Our winter snow and late rains have now percolated into the strata above the subterranean water levels; the extra weight has forced these strata into the cavities below. In all these cases the surface earth subsided, causing great or small quakes without any heat, because there were no chemical nor mechanical causes for it." We may add to this class the late quake about Ipswich, and the frequent little disturbances in the Valley of the Arno. In the latter displacement of matter by water or the want of it, and in the former sapping by water, gave the surface an opportunity of following the law of gravitation. There was no heat in any of these quakes.

The fifth class is a familiar phenomenon. Rock avalanches will happen, landslips must occur. Unsup-

ported masses of earth will accept the law of gravitation when their own adhesion fails to sustain them. Nainee Tal was an instance in India a few years since; it had happened before, but no warning was taken, and many lives were lost by the severe landslip. Many years ago I was travelling between Folkestone and Dover. I pointed out a mass of the chalk formation that must slip. It did so in four or five years, and blocked the line of rail. I have seen other slips sure to take place; luckily those on duty saw and saved them. No one can travel in mountains without seeing the sweeps made by avalanches: every vestige of vegetation is swept away, the crumbling debris stretches from where we stand to the precipice 5000 feet above us, while at our feet and in the vale below are great rock masses hundreds of tons in weight; all came down in avalanches some time or other.

There is no heat in these actions: there may be much friction, but in many years' experience of these I never saw fire. We may look for a moment on the measures taken to warn man of these fire dangers.

Professor M. S. de Rossi, Director of the Observatory and Geodynamic Archives in Rome, lately published a paper on the Ischia earthquake of 28th July 1883, in the bulletin of the Geographical Society, with a view to find out if the "phenomena before the catastrophe were scientifically capable of foretelling what happened." A translation of this document was given to me by a friend, from which I gather that "seismic movements" were felt officially in many parts of Italy about eight days before the catastrophe, and in Ischia about fifteen days.

"All these symptoms preceded the earthquakes at the same place in 1881–82 and in 1853." On the 28th "there were tremblings all over the peninsula," and he thinks "the precursors did give cause for a warning." But if false alarms were sent "people might sleep out of bed." One night on the rocks might perhaps be preferable to an eternity below them; the Professor allows that "if the facts of Casamicciola from the 20th had been communicated to me I should not have hesitated an instant in warning." He thinks that a system for "seismic centres" might be arranged to "notice geodynamic movements." He then writes of the "fractures of the volcanic apparatus." First there was a raising upwards, and then "a shaking" by a "seismic wave," and so "the terrible shock was occasioned by the explosion and diffusion of the masses and volume of the volcanic vapours." There was no fire after this quake, but gases escaped before, during, and after in such quantities that, on the 4th of August, an officer on duty retired his fatigue party, because "the volume of vapour rising from the geysers" was like an eruption. The paper ends by thinking that by the phenomena preceding this and former quakes at Casamicciola "we are forced to the conclusion that the shock of 28th July 1883 was an effect and a manifestation of the volcanic dynamission of the non-extinct Epomeo." I must here observe that I met a lady at Homburg, in Germany, at the end of July, who had left Casamicciola on the 3rd—twenty-five days before the quake—because the subterranean grumblings disturbed her sleep. She warned several people without effect. But the Professor did not

know of these long previous notices of the coming fall.

Now, as to the extinct or active Epomeo. The whole western coasts of Italy, including the islands, are more or less full of the sedimental deposits formed from the sunlight production on the plateaus, that once existed on the site of the present Alpine range of rugged mountains. From thence came the sands, the lime, and the flints to form the Apennines, and against this barrier the lighter wastes, or surface denudations, of those now removed soils were heaped up, year after year, for many millions of seasons. There is no use in writing of the "fracture of volcanic apparatus;" the whole coast gives out hot springs, volcanoes are extinct and active, there are unsupported strata in all these regions. There was enough heat generated in the crumbling earth to make the water boil in some springs, and enough to expand and force out those gases which had been long buried with the vegetable and animal matter to which they once belonged. To end this subject Professor Palmieri reported that the above quake at Ischia was a subsidence; D. P. Pioni gave us the constituents of the soil at Casamicciola—azote, oxygen, acids, carbonic, sulphur, nitre, arsenic, silica, chloro bromine, iodine, potassium, sodium, lithium, alumina, calcium, magnesium, iron, and manganese. Most of these are causes for heat in combination with water. Thus we have on or near the surface chemical causes not only for heat but for the subterranean denudation of the rocks, and hence we have chemical action, fire, and water all working together at sapping and undermining.

If those who are paid for inquiring into these natural phenomena could follow nature instead of unnatural books, some good might come from a well-arranged seismic observatory; but the professor at its head should be as dictatorial as Moses was, if he expects to save populations from eternity. He need not think of a volcanic apparatus, it is not intelligible. He should understand that where a volcano has commenced it may go on at intervals, as our pokers set the combustible gas in our coal free while any of it is left. He may be sure that hot springs and mud ejections will continue as long as they seek their level on the surface earth from their subterranean causes of heat. For earthquakes he may consider the condition of the strata on the locality, and the causes at work on their sapping. He may even think of man as a cause; his demand for salt has just produced a subsidence of surface land at Northwich, where water rose, where houses stood; and he may prophesy a time when props will rot in unused coal mines, and meadows with the cattle or flocks upon them, fields with all their crops, forest lands, gardens, houses, and inhabitants may all go down to the pit, under the inexorable law of gravitation, unthought of and unexpected, because man forgets that, while he is looking at his instruments to guess where the danger is, the avalanche has fallen over the precipice, "because it cannot help it."

Another scientific view of this subject may be here entered with remarks upon it. In his address to the British Association at Birmingham, Sir W. Dawson is reported to have said—quoting from the *Times*, 2nd September 1886:—"In these times of full-grown science,

'we should be prepared to find that in this field the new philosophy, like those which have preceded it, may meet with very imperfect success.' The field alluded to is the origin of terrestrial phenomena. He comes to 'general conclusions respecting the interior of the earth,' but allows that we have no means of 'exploration in the earth's interior.' We may observe in passing, that the general conclusions can be no more than speculations of science. 'But the conjoined labours of physicists and geologists have now proceeded far enough to enable us to make some general affirmations with certainty.'"

Before proceeding further, it will be as well to look at the sources from which this certainty has sprung. On some observation I took the liberty of making to Sir W. Dawson, he courteously referred me to the "Chemical and Geological Essays" of Mr. T. S. Hunt. I look at the second edition, 1879, and find at p. 69 modern volcanoes are found "in their greatest activity in oceanic regions where subsidence and accumulation are still going on." P. 17, "The volcanic phenomena of the present day appear . . . to be confined to regions covered by the more recent secondary and tertiary deposits, which we may suppose the centre heat to be still penetrating." At p. 68, Mr. Hall is referred to, to show "that the greatest outbursts of igneous rock . . . appear to be in all cases connected with rapid accumulations over limited areas, causing perhaps disruptions of the crust, through which the semi-fluid stratum may have risen to the surface." At p. 71, Mr. Hunt expands and explains "chemically and geologically" the suggestions of Kefer-stein and Sir John Herschel—"that the deeply-buried

and water-impregnated strata between the superficial crust of the earth and the solid nucleus constitute a region of plastic material adequate to explain all the phenomena hitherto ascribed to a fluid nucleus." Mr. Hunt, however, sticks to this old theme, for "any changes in the volume resulting from the contraction of the (solid) nucleus would affect the outer crust through the medium of the more or less plastic zone of sediments precisely as if the whole interior of the globe were liquid." At p. 73, Le Conte suggests that a horizontal thrust, resulting from this contraction, might produce "not only plications and slatey cleavage," but an amount of vertical extension "fully adequate to account for the upheaval of the greatest mountain chains." This theory of what might be done, if all the arrangements existed, fails to account for mountains with long horizontal formations without folds or plications. Mr. Hunt thinks, p. 74, "that the foldings and inversions to be met with in the structure of mountains may be looked on only as local and accidental . . . to be left out of view in considering the origin of mountains." At p. 76, "the actual mountain formation is still unaccounted for." Then we find hesitation on the clue. "The grave question has arisen as to whether the heat which plays such an important part in the phenomena under consideration is a cause or an effect of the activities beneath the earth surface." Hunt, Babbage, and Herschel maintain that the "heat from a yet uncooled nucleus is the efficient cause of all igneous and volcanic manifestations." Keferstein thinks "that heat results from fermentation among the deeply-buried sedimentary layers." Le Conte thinks

the centre heat acts on the deposits. P. 77, Vose and R. Mallet suppose friction produces heat, and "access of water determines volcanic eruptions." To all these theories Mr. Hunt, p. 78, supplies "chlorine, sulphur, and carbon necessary for the generation of the various gases, which are the frequent accompaniments of volcanic eruptions." From these uncertainties Sir W. Dawson finds the following certainties:—

"No. 1 tells us—'It is evident that the crust on which we live must be supported on a plastic or partially liquid mass of rock.' This certainty is found from 'the wide distribution of volcanic phenomena of similar character.' This ideal fact led to the old theory of a fluid interior of the earth, 'but this is now generally abandoned.' Unfortunately the geological text-books of the day are still using this abandoned heat not only for volcanoes, but for the ordinary varying warmth in mines and wells, and for the forcing up of mountains by the contraction of cooling. It was shown a hundred years ago, and has been shown of late years, that there is not now and never has been any cause for the origin, and no necessity for the use of any innate fire in the body of this earth.

"Sir W. Dawson's new theory is—1st, A 'heated and plastic layer' somewhere below our feet, to be regarded as 'merely an under-crust.' He then comes to No. 2—The earth's body is practically solid, 'dense and hard, yet liquid or plastic for the purposes of volcanic action and superficial movements.' 3rd—This layer is supposed to be heated by the 'action of heat on moist substances.' 4th—This crust is divided into two magmas, one mostly

silicious, the other more metallic. 5th—The melted material is sent to the surface by pressure or water. 6th—The effect of these actions is shown in 'great bends, folds, and plications, . . . mountain chains and continental plateaus.' We may now run back over these six certainties. Continental plateaus have been made by the waste of their own highlands. Mountain chains were the highest undulations of this globe, and were left as the waters slowly retired in consequence of the natural gravitation and sinking of their bed. Plications, folds, bends, and other fractures were caused either by this natural contraction or by the sapping of fire and water beneath the sedimental deposits. Melted matter is not sent to the surface by pressure, but by the expansion of steam and gases under heat. This heat is due to mechanical or chemical action on combustible materials; these materials are produced by or on this earth, and buried with their gases in them. If the ejection is caused by pressure, then, as gravitation of the solid must be perpetual on the plastic layer, the ejection could not cease, when once commenced, till the entire plastic layer was forced up. The cold plastic mass met with in the St. Gothard Tunnel was a proof of this. They could not stop its flow. The material forced up by volcanic eruptions is lava. Pumice or dross, mud, dusts, ashes, metallic matter may be found, but all tell of the burning and melting of rocks that were once deposited by the sea from material derived from the produce of water or land. Sir W. Dawson supposes the plastic layer or under-crust to be part of the solid body, and kept in a hot condition for 'the purposes of volcanic action and superficial move-

ments.' These processes are, however, dependent on other actions. Water is the great cause of surface quakes: it percolates more or less through all deposits. When it meets an impermeable stratum it runs along its surface and saps the lower face of the superstratum. This upper layer, being unsupported, remains suspended over the vacuum till its own adhesive power is overcome and the mass falls in fragments or as a whole. When the fallen area is extensive and deep, the settling down of the broken area takes some time, as happened in Spain three years since, and is now happening in America. When the area is sandy, the fall is near the surface and happens in dry seasons, the after actions do not occur. All superficial movements that do not cause igneous action give the ordinary earthquake. When an eruption ensues the quake is in a volcanic region, and two causes insure frequent local falls of matter. Every atom thrown up leaves a gap below, while the run of water continues to wash away the fragments. Thus quake after quake comes on, and volcanic energy ensues, dependent on the quantity and quality of the broken masses. In both cases there may be a visible sinking of the surface, but in the volcanic much material is thrown up, and the surface of the land covered with it for long distances. If the solid body or nucleus of this earth is 'dense and hard,' it would be practically impermeable. There is no natural reason why it should be hot, so there is a difficulty in comprehending how heat acts on 'moist substances' so as to maintain heat in a cooling globe for an unknown time. The 'bends, folds, and plications' were all formed long ago, and are not in the solid nucleus but

in the secondary formations that were made under the sea surface, or that have sunk under it like our coal seams in the dry land, or like the coral islands that have sunk thousands of feet below the level on which they were constructed. The folding of these secondary formations is the natural result of settling down; the ordinary gravitation of particles goes on always. The slips of slopes, the subsidence of areas, while the sub-strata were soft or hard, fully accounts for all the folds and faults we see. If caused by forcible upheaval from the solid nucleus, why are these bends, folds, and plications only found in the later formations, or in those that were deposited by the sea when the great waters were at a higher level? This question has puzzled our geologists for some time, and much nonsense has been written on the subject. Under these views of natural actions the 'heated and plastic layer' of Sir W. Dawson may be dispensed with. If he had described the heated areas as confined to volcanic regions, it would have been a correct view. We may mention the late earthquake and eruption at New Zealand as an example of locality. The Mountain of Tarawera has been described as a perfect cone, possibly thrown up by frequent ejections of hardening material. The sight has been held in veneration by Maories, and foreigners have been excluded from it. Of late years access has been gained, and pictures of the white and pink terraces tell of the vast quantity of material brought up by the warm waters. There was, therefore, a vast mine under the surface. Several geysers are on the spot, telling of a great water supply running over heating materials. On the 10th June 1886, the

surface collapsed; the beautiful terraces, piled up for many years, all fell in. Red hot ashes were thrown up, and cold mud; no lava. If this is true, and there is no reason to doubt the accuracy of the *Leisure Hour*, we have the simple truth explained as I have previously put before you. The fall of the surface liberated much heating material, and burning ashes were thrown up by the steam force. Then came the rush of cold water, with its pent-up mud, from beyond the heating causes. There was no general hot magma or the mud could not have been cold.

"The heated general layer of hot matter as causing volcanoes and a contracting surface for earthquakes may be at once rejected as not proved, not necessary, and not natural. Sir W. Dawson has rejected the innate fire in the earth's body as the cause of these phenomena. I rejected it many years ago; so we are forced back to the natural causes. Nature's laws do not change. Life, death, and burial have continued since they first began. The earth has contracted by the settling down of its solids. The waters have sunk with their bed. The whole surface could not sink into a smaller space. The highest or firmest undulation became dry land. This land gave its produce partly to the sea; part of itself was carried down the little streams, as it is to-day by the great rivers. Whatever went to the ocean was deposited by it. The greatest deposits are near where rivers do now or once did reach the tides. These deposits, says Sir W. Dawson, 'are necessarily those of greatest folding and consequent elevation.' I deny the elevation, but the folding is simply the result of gravi-

tation and pressure; all the folds, bends, plications, faults, or fractures are found in places and in formations made by, and left by, the sea. It is in these deposits of varied depths that we have our earthquakes and our volcanoes. The cause of heat must be local, and the cause of earthquakes is the sapping by water and by fire together, or by water alone.

"The six certainties of Sir W. Dawson are thus reduced to impossibles. But, in talking of the distribution of dry land, he gave a sentence which approaches so near the natural system of action that I venture to prolong this letter to make a brief notice of it. He is reported to have said—'This leads us to the further consideration that, while the ocean beds have been sinking other areas have been better supported, and constitute the continental plateaus.' The President of the British Association knows that the ocean once rested on the whole surface of the globe, that the present bed has sunk since the polyps began to build the coral reefs in the Pacific some 10,000 feet; that other oceans have subsided to about the same extent; that our coal-fields have sunk over and over again from their dry land levels to become the bed of the ocean, and to be buried over and over again with sedimental deposits by the waters. It is allowed that continental and oceanic areas 'have been in continual movement.' Sir W. Dawson has been guided by 'physicists and geologists.' No one of these have data to start from, consequently their figures, however true in themselves, cannot give the whole truth of this earth's system of action. Sir W. Dawson takes away their standpoint, the innate fire—suggested by Laplace

—without knowing how it originated or how it was continued. He cannot rest on the upheaval system, as founded on that false innate fire. His own ideal of a heated layer is impossible. May I venture to hope that on reconsideration this seeker after cosmic truths will discover that his words near the end of his elaborate and beautiful address were practically a prophecy of a near fulfilment? 'We have still very much to learn, and perhaps quite as much to unlearn.' Let us pray for light on this old and serious subject of beginnings. Let God's light of life be our guide."

There is, then, a unity of action in the classes above detailed; one law is carried out in all, suggesting one centre power. The acting forces and the materials acted on owe their existence to the sunlight. The great factors—air, water, and fire—come from the sunlight, and the energy of the two first is ruled by that power, while both together rule the fire; or, reducing this to the last point, as in all the other letters, the sun is the agent of the God of light. The gases of this earth, as the recipients of that light, respond with life, love, and reproduction; and again with death, gravitation, decomposition, heat and fire.

SECTION VIII.

ANCIENT PHILOSOPHERS.

About 1500 years before the Christian era men of the East are said to have had no books or writings. From the very beginning of man he had nature alone to guide him, and the events of the day to teach him. The lore of the father was handed down to the son; the knowledge of the teacher to the taught. The extent of their wisdom may be measured by their having composed at that time the "Rig Veda." The power of their memory is shown by their repeating the poems of that work. They contained "10,580 verses of 153,826 words" ("India: What Can it Teach Us," Max Müller). From these unwritten poems the manners, customs, laws, and forms of government were derived, and the darkest corners of the human mind were illuminated. However long these Sanscrit slokas took in composing, they were known and recited "1500 years" before, but were not written till "1500 years" of the Christian era had passed away. The wisdom of old philosophers, unknown to fame, had been retained in the memories of man for 3000 years.

There were hymns and songs of praise, of supplication,

and depreciation to their 3339 Devas. These gods sprang up spontaneously, with names applied from familiar incidents. Most of these have passed away, so that the origins of titles are hard to trace. The morning dawn, the midday heat, the evening shadows had their own familiar Devas. Thunder and lightning, cloud and storm, rain and dew, frost and sunshine, all had controlling powers ready to modify action at the prayer of man.

Each event of life, every action of nature, was due to, and ruled by, a special Deva. These poems passed through three forms of Oriental religions. Changes happened in each; crystallisation is still going on; but the pith survives in the general sublimity of worship to their Devas, and in the innocent purity of supernatural ideas. Old names still fill up the slokas, but the myths, to which they once gave a comprehensible form, have given way to one incomprehensible god. This event took place in the fifth century before Christ. As Max Müller puts it, "All the gods had been discovered to be but three gods," of earth, air, and sky; but "in reality there is but one god—Atman."

We are told that "there is no study in the whole world so beneficial and so elevating as that of the Upanishads"—of the second epoch of Vedic literature. "Here," says Max Müller, "the circle becomes complete." Instead of comprehending the one by many familiar names, the many are now comprehended by the one, "The Atman—the self of all the old mythological gods . . . for they were not mere names, but names intended for something" (p. 246).

Max Müller says of this literature—"It opens to us a chapter in what has been called the education of the human race to which we can find no parallel." From it came the "first intelligible development of religion and mythology; the foundation of astronomy, metronomy, grammar, and etymology; and the first intimation of philosophical thought—the first attempts at regulating family life, village life, ceremonial tradition, and contract." Its religions have many coincidences with Christianity. "And," says Max Müller, in a true Christian spirit, "if I do find in certain Buddhist works doctrines identically the same as in Christianity . . . I feel delighted, for surely truth is not the less true because it is believed by the majority of the human race."

The people who composed these hymns, and all the generations that retained them in their minds, had no physical knowledge; they were not guided by the light which cannot deceive, "the light of mathematical reasoning" (Ball). They had nature alone to teach them, and purity of thought to accept the lessons. They may be called by some superstitious; there is a natural feeling of awe in the mind of man, a natural dread of forces greater than our own; there is a terror under sudden actions, and an innate love for the beauties of nature. The accuracy with which they read the open pages is sufficiently proved by the vast development, the long duration, and the general acceptance of the main doctrines through all the changes of still changing forms of religion. It is to these people who lived fifteen or sixteen hundred years before the birth of our Saviour that we owe the idea of light as the first creating cause.

Max Müller tells us—"In the hymns of the Rig Veda the separating and keeping apart of heaven and earth" is several times alluded to . . . "as the work of the most valiant gods. . . . It is Agni, fire, who holds the earth and supports the heaven; it is Indra who holds them apart. Soma is celebrated, and twelve other gods share the same honour." In the separation "there was neither rain nor sunshine." Moses wrote—"The Lord God had not caused it to rain upon the earth." There was one omnipotent then. "There went up a mist from the earth." So the Veda continues—"There was an impossibility of distinction during the night," but a clearing up "of the blue sky through the rising of the sun." The most valiant god of earth was "Agni," the only god who had come down from heaven to live on earth, the friend of man, the messenger of the gods, the mediator between gods and men.". All these old ideas shadowed out the well-known facts of to-day, and are coincident with our Bible teaching.

Max Müller continues—"Soon, however, fire was conceived by the Vedic poets under the more general character of light and warmth." These facts were seen "in the sun, and beyond the sun," "in the ripening of fruits, in the warmth and life of the human body." Agni was now the supreme god, "for without his light heaven and earth would have been invisible and undistinguishable." He had become the accepted "father of heaven and earth, and the maker of all that flies, or walks, or stands, or moves on earth." We thus mark the progress of knowledge and veneration. Old Vedic philosophers taught a god of fire, the Magi worshipped

him in old historic times; a wise old man, the fabulous Zoroaster, reformed that religion. Orientals applied light and brightness as names of their lofty mountains: Gaursanker (source of brightness), Dewalligheri (circle of light). They keep their lighted lamp as the spirit of their Deva for ever burning, and our creed tells us "God is light." Moses found no difficulty in dividing light from fire; it had grown on the older men slowly but surely. This Deva was accepted long before Genesis was written. The coincidences strengthen this book and the Vedas; while the facts discussed in previous sections prove, if proof is wanting, that light is of itself the moving cause of action in all matter in any way sensible to its touch.[1]

I have used Max Müller as my authority, because he is the best we have; but his deep study and his clear explanation of the Vedic truths and the Sanscrit philosophies only confirm what I gathered forty years ago from ascetic philosophers in India, men who still named a familiar Deva for every occasion, who recognised another in the dawn, as their flowers opened their petals to his light, or as the forest they lived in sang its morning hymn; for the sudden touch of light awakes the vast foliage with an audible sound. These devotees say, Why should not the vegetation thank the God of light for the beauties and the odours He has given them? speaking of them and to them as intimate friends. In all their multitude of Devas, in all the myths of the Veda, these men never forgot their one God, the old Atman, the modern Bugwan; but even

[1] See the Burnett Lectures on Light, by Professor G. G. Stokes.

while talking of him they clung to their old poetry, and rolled out their slokas of golden chariots, with galloping horses glittering brighter and brighter as they reached the mountain top, our zenith, and how, as they descended, they waxed feebler and feebler, till they were unharnessed and stabled for the night.

It must be understood here that no theological discussion is intended. There is no Pope or Inquisition now to condemn me as they did Galileo some 252 years ago for believing that the sun was the centre of this solar system; making him swear—"on the most holy Gospels," and with "God's help," that—"I will in future believe all which the Holy Catholic and Apostolic Church doth hold, preach and teach. . . . I abjure with a sincere heart and unfeigned faith, I curse and detest the said errors." These errors had been established facts for thousands of years. But Galileo further swore to "adopt and observe entirely all the penances which have been imposed upon me." Signed Galileo Galilei, June 1663 ("The Private Life" of that philosopher, published by Macmillan & Co., 1870). If I believe in light as the first agent of creation, I follow the Mosaic teaching; but Laplace and modern science have, as the Popes did, laughed and sneered at the superstitious first acceptance of a higher power by the awe-struck ancients. Science has gone on with her accurate figures to prove her data wrong. She has ignored the wisdom of old, acquired by long, careful, and intelligent observation of nature's actions. Wisdom of mortals, guided by Devas in each action, saw truth without mathematics; but figures without data are ex-

pelling truth as certainly as the proud Inquisition did. The Agni, as fire, has stayed on earth from the time when she first felt the light of the sun. If we follow the teaching that, as far as we know, began some 3400 years ago, we find that those philosophers gave up fire, and accepted light as the creating power. We have pointed out that, if the figures of our scientists are true, they unintentionally point to thousands of millions of years as the age of this earth. Yet these men assert that she is only one hundred millions of years old, and that there is no possibility of accounting for the duration of a fire heat for even half that time. Sir Isaac Newton, the farthest seeing man of recent time in mundane matters, suggested a cause for the maintenance of light. The late Sir W. Siemens repeated the idea, but his mode of action was controverted. I have ventured to account for this replenishing of light by the instantaneous action of attraction. The old Aryans had no definition of natural light. It still remains incomprehensible; but we have it in us; it is in all life. We know it gives us warmth, that nothing lives without it, but that vegetation can be partly encouraged by artificial light. We know that light exists without great heat in the animal and vegetable kingdoms; that it is encased in our own bodies as the light of life, the intangible element of creation.

I leave the question, Is light, acting on matter, sensitive to it, a sufficient agent to form a world such as this earth? to the consideration of those who love to contemplate the beginnings.

Before closing the paper, however, I wish to point out

that Max Müller tells us the Vedas were not written till 1500 A.D., though they were known 1500 B.C., while Laplace refers, in vol. ii. p. 250, "Pond's Translation," to tables of astronomy for two epochs, "3102 and 1491 years," B.C. He thought that these tables might have been "constructed, or at least rectified, in modern times;" but they contain evidence of "observation 4300 B.C."[1] If so, there were men in India 2800 years before the Vedas were supposed to be known in a high state of civilisation; and, as there are said to be astronomical records, we may infer that other writings existed of an older date. This subject is beyond the limit of the present inquiry. It is, however, proper to point out, that if Laplace was correct in accepting the oldest date of astronomical observation as having been made 4300 B.C., then as the Mosaic creation was 4004 B.C., there were human astronomers in India 296 years before that time.

Thus, by ancient science and by geological researches, this world is far older than modern philosophers lead us to suppose; and there is evidence in ancient lore as well as in life around us that light, without innate fire, changes earth material from one condition to another; that it initiates and sustains life with motion; that it is now the halo of glory round the sun, and has been there from the beginning as the first agent of creation.

[1] *Nature*, of 16th June 1887, in giving abstract proceedings of the Geological Society, remarks: "In Egypt and Asia Minor civilised communities and large states flourished at an earlier date than 4000 B.C."

SECTION IX.

THE OCEAN BED.

We may now run into the confusion hinted at in the preface, and make some general remarks, all tending to show the "Rule of Law" as established by sunlight. When all actions in this earth are due to one force acting on the same materials in different combinations in varied modes, repetition in action and in history must occur. In the beginning of these desultory sections, I beg once for all to apologise for the unavoidable repetition, resulting from different points of the same subject. The first point before us is embraced in the question: Has the sea sunk—or has the dry land been upheaved? On December 21st, Major Greely told the Royal Geographical Society that his opinion inclined to the upheaval of land from the sea. On October 15th and 22nd, *Nature* republished a very interesting lecture by Mr. John Murray, where we find—"Throughout all geological time . . . the deposits appear to have been pushed, forced, and folded up through the secular cooling of the earth." In these lectures we find opinion only. On looking into the *Science Primer*—edited by Professors Huxley, Roscoe, and Balfour Stewart—(Geology), Pro-

fessor Geikie, p. 99, we find—"It is the land which rises, not the sea which sinks." This primer is circulating through our schools as backed up by the first science of the day; and the dogma just quoted is generally accepted. There is no greater authority on this upheaval than Sir C. Lyell. All through his early life he was positive as to the action and its lateral extension. On January 22, 1829, he wrote: "If the tertiaries from the North of Italy to Cape Passaro shall ultimately correspond to my present view of them, they will, I think, establish for ever the elevation theory." On February 5, 1829: "I . . . am almost certain that my spick and span new theory on this subject will hold water." On August 16, 1874, his ideas changed: "I have been long thinking that we may be under a great delusion when we find proof of upheaval in ascribing to the movement an almost indefinite lateral extension, whereas all the evidence which we have in regard to the modern effects of earthquakes runs quite in a contrary direction." Sir Charles was an honest man; at the end of his life he did not hesitate to show his mature thoughts as to the petted theory of his youth; he inserted the wedge of destruction, but hesitated to drive it home, and left the upheaval without its lateral effect. Well, what is the lateral effect? The earth began to shake so as to affect the seismometer at Vesuvius, about July 15. Subterranean noises were heard at Casamicciola on July 5, and the great earthquake took place on the 29th. The tremor was felt some 40 miles away, but the actual subsidence was confined to a small area. The quake at Vesuvius was not considered decided enough for Professor Palmieri

to issue a warning, and he scarcely knew in which direction to send it in such a quakey region. The English lady who heard the noises on the 5th told her friends what was coming, left Ischia immediately, and told me of the catastrophe at the end of the month in Homburg. The physical effect on the area of a quake depends entirely on the conformation of the strata and their condition at the time. Some are not sapped by water or by fire, some are self-sustaining in their whole extent, some are sapped only partially, some formations are very small, some very extensive; there is no end to the various conditions any one area of surface may be liable to, and therefore it is difficult to say where or how far the lateral effects of quakes may be felt. One thing, however, is certain: the local action of an earthquake is subsiding. We can now go on to show that the sea has sunk, and the bed with it. The present sea surface gives the measure of our physiographical level. The dry land rises to about five miles above, the ocean bed sinks about five miles below, that level. This bed is perpetually replenished by the burial of its own dead animals and vegetations, as well as by the river carriage to it of particles and solutions brought down from the dry lands. Science has thrown this question of deposit into some confusion. Their object was to show that this earth has existed less than 100,000,000 of years; but, as the geographical measure of the watershed has been taken instead of the physiographical, we can place no confidence in their conclusion, that one foot of the solid surface is removed in 6000 years. Mr. Murray limits the deposit of river material from 30 to 300 miles from the present shores.

This depends on the nature of the material, on the river force, and on ocean tides and currents. Tropical productions are found in arctic regions. The evidence of upheaval is supposed to be found in the broken-up condition of the land near the shores, in consequence of the "secular cooling" of the earth.

SECTION X.

OLD DOGMAS.

A SCIENTIFIC difficulty has to be cleared away here: there is actually no proof that this earth was ever hot. The teacher of the molten world, Laplace, told us in vol. ii. page 363, "System of the World" (translation by J. Pond, F.R.S., 1809):—"This view, therefore, of planetary motion leads us to think that, in consequence of excessive heat, the atmosphere of the sun originally extended beyond the orbits of all the planets." His view may have been wrong, for we are ignorant of planetary motion, and his heat of earth, as an offshoot from the sun, was an idea depending on the supposed heat of this orb of light. Modern philosophers have put heat as a dogma, because they have found that certain heated vapours in their laboratories are similar to the vapours in the atmosphere of the sun, as shown by the spectroscope. They forget that extremes meet, and that liquids and solids have been formed from gases under cold pressure by Raoul Pictet and Cailletet, or as Mr. Grove put it, "Frost performs the effect of fire" ("Chemical and Geological Essays," Hunt, p. 37). Some philosophers seem also to forget in our glowworms, fireflies,

many luminous fishes in the sea, and the glowing crustaceans kicked up in the snow by the sailors of Nordenskjöld, that light can exist without more heat than is necessary to support life, while nothing could exist in the excessive heat suggested by Laplace. Moreover, it is still unknown how the ideal heat originated, what there was to burn, or what became of the ashes. When this hot theory, commonly called the nebular hypothesis, was promulgated in England early in this century, some of our geologists were puzzling their brains over the formation of certain rocks. Mr. Hutton was said to have danced with joy at the discovery of a once molten mass in the cold rocks of Scotland. Other geologists have jumped to the same conclusion, and so Mr. Murray assumes the "secular cooling" as a fact. In spite of this ideal action, which necessarily implied a great contraction, and in spite of the fact that a contraction of the solid necessitated a subsiding of the sea, our physical teachers are telling us, "while old land is submerged beneath the sea, new tracts are upheaved, to be clothed with vegetation and peopled with animals" (Geikie, "Physical Geography," p. 131).

Perhaps the most curious point in the science of cosmogony is the uncertainty as to the formation of air, water, and solids out of a nebulous mass. On this uncertainty hang the futile attempts of certain philosophers to mix up or to combine cosmogony with the Bible teaching. They fail from their starting-point. Even Professor Huxley, while destroying the confused stream of Mr. Gladstone's words, and making it run to waste, trusts to the fire of Laplace in preference to the light of

life. If we begin with this as the first active agent of creation, as the cause which stopped the nebula in its idle gravitation, to convert that motion into the path round the centre of attraction, we find the nebula itself full of gases in sympathy with the light. We see this sensitive quality to-day in the soil, the water, the vegetable, and the animal. The law that rules this world has never changed. The evaporation of to-day draws off the gases from surface matter, dead and living. The liquid gases meet the cold of the atmosphere, they condense, and fall back to do their duty upon earth; the aerial gases go on to form the air. In doing this, they escape from the zone of warmth that encircles earth, and become purified and rarefied by excessive cold. It is this cold pressure that separates the earthly atoms from our high atmospheres to produce the fair spectacle of a meteoric display. In this action chemical affinity or electric magnetism draws atoms of a circle to a point; a body is formed, and on formation it falls. In this fall some bodies burst, to squander their glowing sparks high above us, but destined to return to earth as meteoric dust; some retain their bodily form, and return to earth as concreted bodies containing matter that is connected with earth. Laplace told us part of their aerial history. From this evaporation law we trace the air and the liquids. As they were withdrawn the solids were left to consolidate into the nucleus of this globe, while the meteoric dust gave a covering to the whole. Nordenskjöld lately found that basalt contained the constituents of meteors. This may possibly account for the appearance of this rock as great thin sheets over vast areas,

while in other places it was washed away from the surface to form masses of basaltic deposit by rivers or by seas. Under this system of attraction and separation, our air and water are constantly replenished; while there was no chance of creation or construction in the ideal molten condition of this sphere. Science has never got over the difficulty of heat in reference to life; but with the system now proposed there is no difficulty. Light, accepted by the germ, gave life, as a temporary tenure, to a casket formed of earth. Thus the solids are constantly repaid their loans to living bodies of the vegetable and animal by their deaths and burials. By this system the whole body of our sphere has grown, till the sedimentary deposits are locally several miles in thickness.

SECTION XI.

THE OCEAN BED AND SCIENCE.

THIS surface earth of to-day is composed of materials that at some time or other belonged to organic structures; denuding forces act on this, and have reduced the original body from a smooth undulating mass, as left by water, into the pinnacles, precipices, gorges and fractures that we see on some coast lands, and in the mountain ranges. All that has been removed has gone to reconstruct other areas; some is blown by winds, but most is carried by water; every rill gives a contribution to the river for distribution on its journey, all the rest goes to the lake or sea. This has been the process ever since the dry land appeared. With all this labour of sunshine and frost, wind and water, the land has not been moved into the sea, but rises from it either in abrupt cliffs or with a gentle incline in varied undulations, till in some places it reaches a height of about five miles above the sea level. The present ocean bed, as discovered by the *Challenger*, has a general gentle slope from the shores; there are great plains with some elevations and some valleys, here and there precipitous ledges and reefs. The surface is generally covered with soft materials—ooze, mud, clay, loam, or sand are all frequent. Here

and there volcanic material was discovered, and hard ground met the sounding rod occasionally. All the deep soundings told of marine sediments; near shores they brought up land refuse and sea deposits. The conformation of the original sea bed is unknown; the dry land is made in layers of stratifications as a rule, with unstratified masses here and there. Some of these are attributed to igneous causes, while the others are all laid down by water. Calculations have been made as to the time occupied in bringing our sphere into its present condition. Professor Croll makes it under 100,000,000 years, and endeavours to prove it by the rate of denudation. He tells us:—"In order to determine the present rate of subaerial denudation, we have only to ascertain the quantity of sediment annually carried down by the river system." An accurate measurement of the watershed area is required; but Professor Croll uses the geographical measure. This is far too little, and therefore the whole calculation must be wrong as to time and denudation.

As to time, we may remark in passing that, if the sun is 100,000,000 years old, and if he cast off the ring to make our earth in as hot a condition as Laplace supposed him to be, then the sun and earth were about the same temperature. We do not know how the ideal heat of the sun is renewed; but if his light is dependent on heat, there must be some means of keeping up the fire, while earth has no necessity for the fire as far as light is concerned, and therefore no occasion for its renewal. We were told at the last meeting of the British Association that the earth is solid, yet her volcanic action is as persistent as ever. We shall see presently that vol-

canoes do not come from any innate inherent heat; so that, if these eruptions do not depend on that source, there is not now, and never has been, any occasion for an internal innate fire. (Science has now given up this fire as shown above.) If we give the sun a diameter of 850,000 miles, as containing an ideal heat for 100,000,000 years, then earth with no more supply than she got at first only had enough for 941,178 years. We may consequently give up the heat theory as an unknown cause, and look for some other to account for the present condition of our mother.

Mr. Croll tried to calculate earth construction rate, but ends his chapter without a conclusion. He objected to the rate, 100,000 feet in 1,440,000 years as suggested by Mr. Huxley; yet by this we reach a tolerable age for all that has been done. It has been shown by Mr. Powell, in his "Geology of the Uinta Mountains," that, if three miles of dry land have been removed, there are at least three left; therefore, six miles were constructed in 456,192,000 years; by adding the ideal time of denudation for the three miles, we reach 550,232,000 years, a very moderate computation when 5,000,000,000 years have been suggested.

Whatever the lapse of time has been, the whole dry land surface was once beneath the sea. It was deposited as deposits are left now, in large plains, in undulations, and inclines; over this the yearly growth and death of organisms have scattered their remains; we still find marine relics on our mountain tops, in our mines and quarries. How came these things so far above the present level of the sea?

SECTION XII.

GRAVITATION AND ATTRACTION.

LIGHT, as the first agent of creation, brought two forces on the scene. One, gravitation, was developed by abstraction of gaseous matter; the other, attraction, became the assistant in construction. It has been suggested by Dr. Duncan, Sir R. Grove, Williams, and others, that the "sun is slowly attracting to itself the greater part of the earth's atmosphere" (see Hunt's "Chemical and Geological Essays," preface, p. 6). The nebulous mass, having in it gases sensitive to the agent, became attracted to its centre light; the normal gravitation of the nebula was instantly converted into its present orbit. With this revolution and its ordinary rotation on its own axis, the mass obtained the sphere form, so that no part was hidden from the light. It has been already shown how evaporation drew up the aerial and liquid gases, and how earthy atoms were separated from the air by cold pressure and by vegetation. These atoms were supposed by Laplace to remain in the air for a time, and if their equilibrium depends on the atmosphere of this earth, we have a cause for the glorious sunsets and wondrous after-glows of 1882 and 1883 in their dry seasons. As a rule, these dusts

were supposed to form meteorites by chemical or magnetic attraction. As such they fell back by gravitation to the body, to amalgamate eventually with the soil. As dusts[1] they fell everywhere, and gave a coating to the whole sphere. The evaporation never ceased while the surface coat was forming, so that, as this gained weight, it fell into the vacuums that constantly offered themselves in various areas. This process of construction began while the nebulous mass occupied the entire space now held by our atmosphere, so that the rarefaction of the air must have been one of the first, though slow, results of a simple but beautiful arrangement. The earth sphere, as in love with the light, might roll round in the ether of space without friction. Our envelope of air thus took the outside, while the next, water, as falling like dew, occupied or rested on the surface of the solid. This surface was liable to gravitate as areas became undermined by the escape of gases—by the run of water, or eventually by the action of fire. We shall come to these presently. Our object here is to show that this world, constructed under the action of light, must have been a sphere going through the process of gravitation in its atoms and its areas, whenever an area or an atom found an opportunity of subsiding.

Having thus got rid of a fire-made world, we may return to Mr. Murray. He thinks he finds evidence of elevation in the coral islands of the Pacific, and he finds them areas of "great permanence and stability." His reasoning is curious, in making their structure and

[1] *Nature*, 14th April 1878:—"All night it rained stars, but we saw none fall to the ground."

present condition as dependent on "the truncation of some submarine cones through breaker action." These cones are supposed to be of volcanic formation. Such areas are, perhaps, the most unstable on the face of this earth. There is no evidence that volcanoes ever existed under these reefs and atolls, but it has been stated that coral-building polypi are destroyed by volcanic action. They do not build below 20 or 25 fathoms, but the coral formations go on to more than 1000 fathoms. Professor Dana considered this a proof of subsidence. When he found coral islands 300 feet above water, he considered it evidence of upheaval instead of a stable area; while he put the entire subsidence of the Pacific Ocean bed at about "10,000 feet," and found that the great mountains of the world had gained an equal height in about the same time. There is no false evidence in these facts, but they tend, with others, to prove the sinking of the sea by the gravitation of its bed.

The next witness before us is the coal-mine. We use it for two cases—one the ideal innate heat of this earth, the other for the local subsidence of solid matter. Mr. Bryham, the obliging director of the Rosebridge Colliery, has sent us a section, the figures of which help to explain the subject. The depth now worked is 2443 feet, but there is thin coal at 3525 feet. There are seventy-four seams in all, supposed to have grown on the surface of dry ground. The aggregate depth or thickness of these seams is about 33 feet; but the sediment between them gives 3492 feet (about), while the mouth of the mine is 200 feet above the present sea-level. The first coal found is buried beneath 153 feet of water-laid strata; the first

good coal is 403 feet deep. There are seams of coal, once vegetation, 3500 feet (about) below the level on which it grew. There is coal in Assam on the present surface of the earth 60 feet in thickness; this must have been deposited while the sea was at a much higher level than it now is—it must have been covered over and pressed down by other deposits. As the ocean-level sank these deposits have been removed, till the great coal-seam is left to tell us of river forces that once collected the mass of vegetation to form this coal-bed. There are no data for estimating the time occupied by the growing. Estimates have been made of earth construction. Professor Croll finds fault with all, but comes to no satisfactory conclusion. We say no more about it here, except to observe that, with constantly varying materials in quality and quantity, handled by the fickle forces of wind and water, there are no data for any accurate estimate. Professor Croll made a strange remark in *Climate and Time*, page 392, on this point. "The mere fact of an area having been under the sea does not imply that there has been any subsidence or elevation of land. The submergence may have been due to oscillation of the sea-level." This oscillation is said to have taken place "during the severest part of the glacial epoch" (page 393), while the last cold time extended over "160,000 years," so that the last coal-seam at a depth of 153 feet was buried about the beginning of that period; but Croll gives "80,000 years" as the duration of the cold (page 328). Then, if 153 feet depth of coal began to be buried 80,000 years ago, the coal-seam at 3525 feet began to be buried about 282 millions of

years ago on this earth only a hundred millions of years old.

There is, then, a second hitch as to time; so we may as well leave off guessing. The subsidence of the coalfields all round the world proves the contraction and solidifying of dry land. Thus we find a universal sinking of solids that once formed the ocean-bed. We can now go on to heat and light to find an answer to the question at the end of Section XI.

SECTION XIII.

THE OCEAN-BED AND VOLCANOES.

We now call on an important witness to give evidence of gravitation, fire, light, and warmth. He can also tell of energetic construction; this is not the upheaval by "secular cooling," but only a local eruption of melted silicious matter, attended with steam, gases, ashes, and pumice, the dross of the melted material. This witness, the volcano, has long been suspected of vomiting forth the innate internal fire of the earth. He has broken out in many places in the ocean not far from land, or on land near the sea. Mr. T. S. Hunt tells us, in his "Chemical and Geological Essays," p. 69, volcanoes are in their greatest "activity in oceanic regions, where subsidence and accumulation are still going on." His energy is always temporary; in many places it has ceased. Under the system of light and warmth there is plenty of time to look back upon; there was no waiting till the water and the earth got cool. There was light enough for life when evaporation first began. There can be no doubt but that the waters brought forth, and an equal certainty that life began on dry land when it first appeared. All that happens to-day in the process of

denudation happened at that time. The little rills washed down something, and every atom so moved contributed to the growth of land. Those rills commenced their career from the summits of the first high lands. These have lost two or three miles of those heights; in mountains we fall in with dry gorges, that were cut by those early streams before they lost their watershed. We need not speculate on the first extent of dry land; but as receding tides show us some extensive banks to-day, we may suppose that the first dry lands were shelving banks. In whatever shape they were, they have sent down the waste of the surface from that time to this, and the banks that were then just left by the sea, still tossing its white spray over them, are now hundreds of miles away. However distant the ocean may be, rivers find their way to it; they are now, and always have been, carrying to the waters such refuse of the dry land as came within their grasp. A vast amount of this material is worked into solutions, some floats down stream, and some is rolled along the river-bed. Much of the latter remains in the river-course, but most of the others eventually reach a lake or the sea. The largest portion of this in early days was vegetable matter; however much it may have been comminuted, all the particles retained their share of the light under which they had grown. As this sheet of paper, after having been reduced to pulp in water, still retains and can give back that sunlight as fire, so all the vegetation moved down to the sea for deposit by its currents and its still waters held in each particle the leading principle of its existence, with the power of reproducing light under various con-

ditions. All these deposits are lodged on the ocean-bed at 60 or 300 miles from the shores, according to Mr. Murray; but we have fossils and recent deposits from the tropics in the Arctic regions. Without speculating here on changing elements, the distance is of little consequence—all the materials were deposited somewhere; ocean currents keep like weights together, therefore persistent forces lodged similar vegetable solutions or suspensions in the same localities for long epochs. When the Upper Pyrenees sent their waste productions to the Atlantic long before man was there, some of it was deposited below the now extinct volcanoes of Auvergne; the productions of the Alps and possibly of lost regions were moved on to the site of the Bay of Naples. These furnished their old sunlight bred and nourished organisms for the eruption of Vesuvius, the Lipari Isles, and Etna. All these deposits were buried for thousands of years, till accident brought them into action again. Mr. Robert Mallet puts ignition down to friction; some have assigned it to chemical action; but when we know that air can be ignited by pressure, it is quite possible that this acting on the gases may expand the natural warmth and light of these old deposits into fire.

If the combustible material is plentiful, if it is broken up by a quake, if gases and steam expand sufficiently, an eruption takes place, limited to the extent of those forces. The action is spasmodic, while, if it came from the ideal fire or molten mass in the centre of the earth, there would be a continued ejection, because the pressure of the soft interior must be persistent on the liquid; so we come to the gravitation evidence. In all volcanic

eruptions much matter, either melted or solid, is thrown up. Vacuums are thus left below. The material above this vacuum has acquired some firmness and consistency by long pressure and consolidation; it does not give way to the sapping at once, but frequently, after heavy rain, these sapped areas do give way under the simple law of gravitation, and fall into the empty places because they cannot help it. These are the earthquakes that generally precede volcanic energy; the force of this is entirely dependent on the quantity and quality of the combustible matter broken up and ignited by this act of gravitation.

There may or may not be a visible surface depression by these deep earthquakes, but non-volcanic earthquakes often take place with surface subsidences. If on land, we see the sinking; if on the ocean-bed, we only see the effect of a sudden subsidence, like that caused by the last great quake and volcanic action in Java, where the sea-wave is said to have gone round the world. Wherever these subsidences do take place the waters must sink also. We thus learn that wherever volcanic action has taken place the products have been added to the surface of dry land, while this surface has in time filled up the cavities on dry land as well as on the ocean-bed. This degradation on the surface is not, however, due to "secular cooling" of the whole body, but to the combustion of deposits in local areas. In all these energetic actions we find evidence of sunlight given, retained for a time, and then returned in fire, liberated gases, and escaping steam. All these phenomena tell of warmth, light, and growth as plainly as do the wood or coal in our cheering grates; we see what this black mineral comes to, and

know that fire is a destructive and not a constructive element. Thus the evidence of volcanoes proves destruction below the surface of dry land, and below the bed of the ocean, leaving to time and circumstance the natural gravitation of the undermined surface with the consequent sinking of the ocean-level.

It matters not here whether this earth was created by destroying fire or by constructing light. Under either condition the gravitation of atoms necessarily produced subsidence of the sea-bed locally, while the entire surface of the ocean sank slowly. This is the normal gravitation. We have just shown the effects of subterranean fires. They take place under water as well as on dry land. Earthquakes happen in both places; therefore there is a general degradation of surface areas. As the same subterranean conditions may exist for long periods, degradations may be frequent. Whenever they take place under water this must sink. The process has been going on ever since organic life began; therefore we find the relics in our quarries, mines, and on our mountain-tops. Consequently these things were all left where we find them by the subsidence of the ocean-bed.

SECTION XIV.

THE OCEAN-BED—SUBSIDENCE, DEGRADATION, DENUDATION.

As the question at the end of the third section on this subject is now answered, it is time to define what meaning attaches to certain technical terms used in this essay. Subsidence means the settling down of surface solids by the general law of gravitation in areas of any size. Degradation means the settling down of any area when the natural supports are accidentally removed. Denudation is the removal from the surface of any quantity of material by natural causes. Deposit is the settling down in a new place of any material in any shape when put in motion by wind or water.

Under the dominion of light the nucleus of this world was inevitably covered with water. Evaporation having commenced with the nebulous mass, and this evaporation returning at once as dew from the cool air, it necessarily covered the entire surface of the solidifying sphere. As the evaporation continued, this solidifying crust necessarily subsided into vacancies left by the withdrawal of aerial and liquid gases by the light. The waters followed all these subsidences, till in course of time the general sinking of the level left the highest undulations as dry

land. As the law of evaporation must have been regular, the general character of the surface was not affected by it; but the return of meteoric dusts from the evaporated gases placed materials at the disposal of water, to be used by this element in the same way that it now treats dusts and solutions. Under the natural forces these dusts were deposited as undulating or drifting matter on the irregular surface of the solidifying body. We have no data to explain the nature of the currents that existed in those dark days, but with a growing light there was warmish water on the surface, with colder down below; surface currents, therefore, ran from the tropics to the poles, and sub-currents ran from the poles to the tropics. There was thus a general circulation of the entire liquid envelope of the globe, while the duration of light in the northern being longer than in the southern hemisphere necessarily developed evaporation, and drew more matter to these regions.

We cannot say what the initial solids were; but if we take the mountain-tops, and what we suppose to be azoic rocks in the body, as the earliest solids we know of, and look at secondary structures, we may safely infer that primary formations were more or less silicious. The vast quantities of old and new red and grey sandstone masses tell of great areas, all denuded, all given up to water trituration, all tossed about and broken up into minute sparkling crystals, often containing quartzite veins telling of cold silicated percolations, the entire masses leading to the conclusion that the primary rocks from which they came were all silicates. In their ordinary process of denudation these old constructions broke up into

boulders, pebbles, gravels, sands. Through all of these beds silicious solutions found their way, converting their accidental gatherings into conglomerates of many sorts. We find whole hill-tops, such as the Righi, composed of these old broken rocks, while in the Tyrol conglomerate quarries are sought for to build with. Individual masses of more than a ton weight may be seen surrounded by smaller or larger fragments, all cemented together by silicious liquid, with the joinings firmer than the body of the stones. These stones are mostly unlike any of the rocks on the mountains now, but belonged to those structures when they first became portions of dry land.

Man has learned much from nature, but he has acquired his perfection of concrete masses from the simple action of old nature, in breaking up hard matter under the forces of denudation, degradation, and subsidence, heaping them all together, and leaving them alone till her own silicious liquids ran through the entire mass, cementing together marbles, granites, basalts, porphyries, shales, slates, and sandstones into vast masses of strange conglomerates; while the same silica forms the clear crystal, the common flint, the striped agate, the dark obsidian, the ruby, other precious stones, and the carbon-filtered diamond. Some of these formations are very frequent in mountain regions; some are extensive and some small. In no case have these structures been raised from the position in which they were formed; but the conglomerate formation could not have taken place unless the individual masses had rolled down from the uplands, as rocks and stones are doing to-day, all to find accidental resting-places till the demands of man bring them into

use. There is then no occasion for any upheaval in these secondary formations, for all belong to the great history of denudation, though their broken masses are found hundreds of feet above the sea-level, and though each separate collection of these fallen stones fell into the sea as it rolled at the mountain-foot, and stayed there cementing the fallen rocks together with its liquid silica till it slowly subsided to lower levels.

SECTION XV.

THE OCEAN-BED AND CRUST OF THIS EARTH.

THE crust of this earth, as referred to by Professor Geikie in his "Primer of Geology" (1876), is now to be briefly considered. This crust is a sedimentary deposit said to be ten or twelve miles thick; in it we dig our mines, wells, and quarries. It has been discovered in these diggings that many of our rocks "are not now in their original positions;" some formed "part of the sea-bottom, and deeply buried coal-seams were once forests on the surface." The Professor asks how these changes could happen, and endeavours to explain it by "one of the simplest examples, and one which many of us may have an opportunity of verifying for ourselves." This permission is accepted. He selects "a low flat terrace bounded by the sea on the one hand, and by a cliff on the other;" this cliff may have caves in it; we can picture the sea covering the low terrace and washing the cliffs. There is ample evidence that this was once done; therefore, there has been "a change in the coast-line."

"The difference of level between the present beach and the old one" is put down at "twenty feet;" so "it is plain that the land must have risen or the sea must have

sunk" to that extent. The Professor allows that a change of water-level in one region must continue round the globe; so if the sea had sunk from our terrace by twenty feet, there must have been "a general lowering of the sea-level." It is then attempted to be shown that this has not happened. At page 97 we are told:—"If the terrace had been left by a sinking-down of the bed of the sea, you should meet with a corresponding terrace all over the globe." With all due deference to Professor Geikie, this corresponding terrace is a simple impossibility. Terraces, or raised beaches, are only made here and there, where the materials abound, where the winds and waters can use them, and where the shores accept the raised beach deposit. This condition is allowed by the practical geologist, who also finds "a series of terraces rising one over another, each marking a former coast-line." In Norway there are many of these beaches. Some stand 80 feet above the sea at that end, while at the land end they may be 90 or 100 feet. Here again the Professor thinks the impossible. If done by a sinking of the sea, the terraces "should all have been as horizontal as the sea itself," and traces of terraces should have been found "at corresponding heights all over the world." Then on this evidence Professor Geikie sums up his case:—"It is the land which rises, not the sea which sinks." Sir C. Lyell came to the same conclusion ("Elements of Geology," p. 99; 1874). By this process "it is easy to see how there should be terraces in some countries and not in others, and how the same terrace should vary in height at different parts of its course." These raised beaches consist of "gravel, sand, and other

beach deposits. Every such raised beach points to a former sea margin, and to an elevation of that sea margin into dry land." Where many terraces are found one above another, they show "how the land has been raised up at intervals for a long period, the time when the land was stationary between two upheavals being marked by a terrace or raised beach." The Professor is not quite satisfied with these dogmas, but tells us that in Sweden "we can detect the ground in the very act of rising;" for rocks have been marked "where high water reached them, and in the course of years have been found to be considerably above their former level." It is gathered from these measurements that the land "is rising at the rate of about two or three feet in a century." The process is described as "gentle and quiet," but not "regular or uniform"; some parts have been more upheaved than others, for some shells may be found "at a height of 20,000 feet." The section ends thus:—"By this kind of evidence it can be shown that by much the greater part of the dry land has been raised, piece by piece, out of the sea, and that the movements have been far from regular or uniform."

In the next section Professor Geikie proves that parts of the earth must have sunk down. He gives the evidence of subsided forests. These are proofs of "subsidence of the earth's surface, just as the raised beaches are taken as proofs of upheaval"; but he "cannot believe that the sea alters its level to any appreciable extent"—on the contrary, he shows that, "where the sea seems to be encroaching on the land, it is the land sinking below the sea." This is proved by the sinking of land in Green-

land, where houses have been removed inland; then our sinking coal-fields are brought in, and very good evidence they are of the long sinking of surface lands into the sea, for the sedimentary deposits of the sea have buried these old forests by thousands of feet. The Professor has neglected to use Dana's "coral islands" as proof of a sinking ocean-bed, but his general subsidence of the entire Pacific was about "10,000 feet," and the other oceans were similar; while the rise of mountains necessarily kept pace with the unavoidable sinking of the sea-level. In the whole evidence brought forward by Professor Geikie there is none whatever of actual forcible upheaval; all we learn is that there has been a change of level in old time, and recently this change has been quiet and almost imperceptible to the extent of "two or three feet in a century." We are nowhere told how long upheaval has been going on; but as the whole theory depended on pressure, and on the secular cooling of an ideal molten body, it must have commenced when this body began to cool. Mr. Croll limits the age of earth to less than 100,000,000 years; so the two or three feet in a century should have given us mountains about 200 miles high if the upheaval theory were true. As to the imperceptible motion, we have no quiet movements of earth; we feel the slightest movements on the dry land, and the oceans tell by their waves of all spasmodic movements on their beds. If we accept the sinking of the ocean bed as proved by the coral islands, and the surface forests that have been buried by ocean sediments, we have direct proof that the terraces or sea beaches are not due to any upheaval action, but to the slow certain

sinkings of the general sea-level, caused by the local subsidings of the ocean-bed. Any forcible uplifting of the friable-raised beach must have broken the line. The elevation of these beaches at the land end, and the depression at the other, is also direct proof that such beach ridges are now on the spots where a slowly-retiring sea left them. The horizontal parallel lines could not be as they are unless they had been left by a retiring sea after long action on the same level. We see the whole action on our own coast; these banks are only raised in certain places, and not all round the shores. We have many ridges on some tideways, each due to more or less wave force, or to more or less supply of material; we see them left by the tide every day; each schoolboy knows they are not upheaved bodily. We all know that the waves encroach in one place, and retire in another; the certain sinking of the water-level insures the latter, while the sapping by water-action insures the falling in of some coast areas, with the consequent encroachment of the sea. We have followed out the example as given by Professor Geikie to its only legitimate conclusion. The raised beach is just where the retiring waters left it; the shells 20,000 feet above the present water-level are on the site now where the waters left them possibly some millions of years ago. The layers of oyster shells in the Apennines, now 2000 feet above the sea, are still on the same place as they were bred in many thousands of years ago; not an atom of that sand and lime formation has ever been upheaved. With this brief assertion we must close this section. It is the ocean-bed and the water that sinks, not the land which rises. We must

remember that the entire globe was once covered by water, as the certain result of light acting on sensitive gases. The surface-level of that water was once about seven miles above the present sea-level. The ocean-bed now is gathered into itself, about three times larger than the dry land. There are proofs of subsidings in the Pacific, Atlantic, and Indian Oceans. Our coalfields tell us of subsidings to great depths below water of vegetation; they tell of long burial, in slow succession, of a frequent repetition of sealing up these sunken forests, and a wondrous preservation of their sunlight and the gases they inhaled. Yet with all these great and certain subsidings of the ocean-bed, our scientific men fail to comprehend that the surface-level of the water-envelope must have sunk, and left the highest undulating areas as the foundation of our present mountains and the whole dry land.

SECTION XVI.

THE OCEAN-BED AND THE MOON.

THERE is no intention of referring to the moon for evidence of actions in or on this earth; but the scientific journal *Knowledge* of March 1, 1886, while writing on our night light, remarked:—"Geologists have recognised the fallacies underlying their old ideas respecting the formation of the various features of earth's surface contour. They no longer regard mountain ranges as portions of matter thrust upwards by the earth's interior forces. . . . They regard the great mountains of the earth as among the products of the exterior forces, the action of the sea, rain, wind, snow."[1] Precisely so, as I wrote many years ago; the earth gives her increase, the winds and the waves dispose of it, as material comes under their control, while degradation and subsidence perpetually change the contour of the surface. On this subject Mr. C. E. Rance wrote:—"The strata of the entire cretaceous system exhibits a gradually deepening sea-bottom" (*Geological Magazine*, June 1874, No. 120.)

[1] Sir W. Dawson also allows this action in his address to the British Association in August 1886.

In calculating causes and effects, our scientists have not considered the results of long persistent actions extending over large regions, and have therefore lost sight of the effects left all round the world by long-continued forces acting on similar materials. Thus the prevailing winds and currents of the Pacific laid the entire range now the backbone of America. The centres of Africa, Asia, and Europe were laid down by persistent and fickle forces, and from all these centres the rainfall has never failed to move off material to the slowly retiring sea. Mr. G. Forbes gives a well-known instance of these continued forces. In his "Wild Life of Canara," he tells us: "There is not to be found a single stretch of shingle beach between Cape Comorin and the mouth of the Hooghly; the coast line is everywhere sandy and flat, and the prevailing set of the sea during many months of the year piles the sand along it to a uniform height, forming a barrier through which rivers cut their way" when strong enough. If this is not done, then the surf sands are heaped up and form great lagoons, all enclosed by sands made from silicious rocks, brought down from the long range of western ghauts to be ground up by river floods and a wondrous beating surf till the waters please to deposit them. Thus an undulating coast line of some 1200 miles is formed by ordinary forces. There are on its course some high lands that may be called sand hills. No forces but wind and water have ever been used for these coast formations. There have been no elevations of land between the Bay of Bengal and the end of India, but year by year, epoch by epoch, the streams first, then the rivers as they grew, have handed

on the waste produce of the Western Highlands till they are now hundreds of miles away from that sea which left them where they are, and some 8000 feet above the level of the waters that deposited their long horizontal strata as secondary formations a few millions of years ago. Amidst all the nonsense that has been written about the igneous condition of the centre earth, its consequent radiation of heat, and the contraction with upheaval of enormous matter 40,000 feet in thickness, the quotations from *Knowledge* come like a glimpse of sunshine on the scene. One by one the fallacies of learned men have died out since I began to show them as impossible. I am not alone in new theories, for long since we were told by Sir C. Lyell (vol. ii. p. 211, "Principles of Geology," in 1877): "The doctrine, therefore, of the primitive fluidity of the interior of the earth, and of the gradual solidification of its crust, consequent on the loss of internal heat by radiation into space is one of the many scientific hypotheses which has been adhered to after the props by which it was supported have given way one after another." Now Sir W. Dawson takes up the same theme. Notwithstanding the loss of his first cause, Sir Charles continued his upheaval theory. He put up the Alps 10,000 feet, the Pyrenees 11,000 feet; but "there has been no disruption of the earth's crust," for very ancient fossiliferous strata retain "perfect horizontality."[1] The most curious oversight of so many wise men is their long adherence to the theory of non-sinking ocean, when their own

[1] We may refer to Hunt's "Chemical and Geological Essays," 1879, for more information on this subject.

measurements tell of its sinking, and the highland marine fossils tell of the epochs when they were deposited by the salt waves just before they sank slowly from each high level in its turn. We shall next consider the present condition of the entire solid body.

SECTION XVII.

THE OCEAN-BED AND MOUNTAINS.

We have now to consider the irregular sinking of what was and is the bed on which the waters of this sphere rest and rested. Sir Charles Lyell was the great advocate for uniformity and law in natural phenomena; he knew that our earthquake actions were brought about by irregular causes and new subsidings: yet he found that the "land had been raised, not the sea lowered." In Chapter V. of his "Elements of Geology," 1874, he said that some land had been raised "insensibly," ascertained "only by the most careful scientific observations, made at considerable intervals of time." These appear to have been made by marks on rocks, where the sea touched in one year, and was some feet below the mark in the lapse of a few years. This being the case, he goes on to tell us "there is no evidence from human experience of a rising or lowering of the sea's level in any region." The first remark on these quotations comes under two heads.

1. There is evidence of the sinking of water all round the world, and the marks on the rocks give proof that the process is still going on.

2. We know of no imperceptible elevation of the solid land, while the general sinking of the ocean all round the sphere, as caused by the sinking of its bed in areas of varied size in all regions, is the only natural process by which it could possibly cause the apparent imperceptible rise of the solid land.[1]

Sir Charles tells us that the advocates of a subsiding sea failed to establish their theory, because they found it "impossible to invent any satisfactory hypothesis to explain the disappearance of so enormous a body of water throughout the globe, it being necessary to infer that the ocean had once stood at whatever height marine shells had been found."

This sentence assumes as fact that which never happened. There was no actual loss of water by a change in its bed from breadth to depth; the appearance of dry land by that change is the only fact we know of; the only loss of water from the main body is by evaporation from the beginning of creation; much of this is now used in organic structures, while the rest falls on and sinks into the soil or runs away in torrents or rivers to lake or sea.

It is now clearly proved that portions of the solid body have subsided, or have gone down by degradation area by area, at irregular times, and very often in the same locality; the aggregate area of these local depressions is far larger than the entire present area of our surface dry earth; therefore, as the whole surface was

[1] *Nature*, 16th June 1887: "On the late Earthquakes on the Riviera. The centre of the shock was somewhere in the Gulf of Genoa."

at first the water bed, that bed is now about three times the size of dry land, and there is no disappearance of water except in its surface area.

Modern science has attributed much of the subsidence to glacial times; Mr. Croll thought the weight of ice was sufficient to cause the oscillation of the poles. In a lecture read to the Victoria Institute, Mr. McK. Hughes told the assembly that the mountains were once so high that glacier ice crept down them to the time when "all the land went down from 1200 feet to 1400 feet below its present level." This refers to a spot in England where the land "has not risen again, and lies still deep below the sea." He called this "a great submergence." On another spot "the mountain range went down far lower than it stands at present, and then a reversed movement commenced, and all the land has been coming up, with interruptions, ever since, and from an unknown depth has been again raised up in places to at least some 1800 feet." This quotation is a simple but unintentional evidence of a sinking sea-level; there was proof of water deposit on a high land; and as Mr. Hughes was speaking on a theory of a never-changing sea-level, that high land must have sunk to receive the deposit, which is now 1800 feet above the sea. The natural action on these spots was by denudation and deposit. Old lands were removed by wind and water; deposits grew on till the waters sunk, with the interruptions as noted, till they are 1800 feet below the level on which those marine deposits were left some ten millions of years ago, by Mr. Croll's measure of denudation, or some twenty-five millions by Mr. Huxley's rates of construction. As we

have no trustworthy record of construction or denudation, the time of these sinkings can only be guessed at by the fossils on the spots. So we go on to Mr. Hughes, where we find "there are many sources of error when we regard the evidence of submergence or of elevation." It seems as if these errors originated with men who assumed more than they had any right to do. It has been shown that the "raised beaches" were not elevated by any upraising force, but are still on the spots where the waters left them; but Mr. Hughes spoke of "well-authenticated facts of raised beaches." He thought that movements were always going on, "now up, now down," and he found evidence of greater sinking and greater elevation near the mountains. The actual sinking is proved by coal seams, buried forests, fallen mountain areas, marine shells high up, stratifications on the tops of our highest mountains. The *Athenæum* of 20th January 1887, p. 166, tells of the derived fossils in the Delta of the Nile, and of a surface-worn valley near 120 feet below the surface—all due to the presence and sinking of the ocean-bed with the unavoidable sinking of the waters that rested on it, with the certain result of an imperceptible and slow apparent rising of the unmoved land. There is no evidence in nature of any quiet upheaval by unknown forces in the interior of this earth. We have evidence on all shores of the retiring of the sea from river estuaries and from sea-made banks, while other shores are wasted by erosion of subterranean matter, or by that of the sea wave. We also know that any artificial movements of the shore or the erection on it of groins, tell us of the persistent action of tides and waves

on similar materials. We know the forcible ejections of volcanoes, mud eruptions, and silicious formations, the visibly growing drifts of dusts and sands by wind alone; we see the banks raised in many places along some shores by winds, waves, and tides: these are only raised in places where material is available for their building, and not all round the world, as Professor Geikie supposes. There are three or four of these banks now building, one beyond the other, on some of our shingle and pebble shores, while on either side of these there may be mud or sand. These characters run round the world. There may be many hundred miles of level sand shores at the present moment; by a look at the mountains of the world, we find hundreds of miles were laid down in level stratified deposits in unnoted time. Some of these are broken by local subsidence or by accidental degradation. These certain and constant processes gave rise to the theory of an impossible fixed ocean level, with its wild hypothesis of mountains and continents upheaved by unknown forces.

Under the law of gravitation the physiography of our earth has slowly arrived at its present condition; in this we find certain proof of the gradual sinking of the ocean. As the solids have not been upheaved, as stratified deposits and sea-shells have been found on our highest mountains, it follows that some highland appeared when the waters were "gathered into one place." This process was long and imperceptible; the sinking was only local; therefore the general subsidence of the great ocean was imperceptible, and the supposed rising of the solid had to be measured carefully. There was, how-

ever, some neglect in the work in Sweden: the states of wind and tide at the time of setting the marks on the shore, or the same conditions when these marks were examined after an interval of some years, do not seem to have been noted. We are told that the marks were found some feet out of water; so an elevation of the land was, as supposed, satisfactorily proved; but the fact of a slow rising above high-water mark was true evidence of a slow retiring sea. We have highlands and rivers; these have always carried down the denuded surface material to the sea; the entire distance from all mountains has been built up with these materials, mixed with marine sands, pebbles, gravels, and muds. Over these the rivers have found their way; in many places these have met obstructions prepared for them under the ocean; as this retired, the watersheds still supplied the rivers; these have worn through the obstructions in some places; here and there they roll over and wear them away still, in rapids, cascades, and waterfalls. All these running waters, with a few exceptions, reach lakes or seas; the material carried down builds up the estuaries and fills up the sea. Thus all seas are shallow near the land, and traces of these river-endings in the sea are still visible through many valleys up to the highlands from whence they come. The material all up the courses is still similar to that now lodged in the lake or sea, and the building process by deposit is going on now, as it has done ever since the watersheds carried down their first denudations for deposit. Under this system the latest deposits are most liable to gravitation. This is of two kinds: the atoms press together, and masses

slip down slopes or break away. We see the results in mountains and on our shores, with some fractures, some contortions, faults, and cleavage—all depending on the nature of the gravitating mass. Hard masses cleave and break away—some slip from the mass vertically, some at an incline; soft masses are bent and contorted. We see some of these results in most mountain regions: they have been going on ever since dry land appeared. The incline of dry land is to the water. To this the denudations of dry land are carried; by this they are deposited all in order. Every movement is done uniformly. Material varies. One may run into another, as the soundings of the *Challenger* found in several instances; yet all is done by law.

The subsidence and degradation of the solid are two acts of gravitation on the mass, the deposit another action by atoms. The ocean waters sink by these first actions; and, however irregular they may be, there is only one uniform result that can accrue from them; that is, a general slow subsidence of the ocean level, and the consequent appearance of more dry land.

SECTION XVIII.

THE OCEAN-BED SINKING.

It has been sufficiently proved that the general surface of the dry land all round this sphere has not been upheaved by any interior force; that the entire surface was once the ocean-bed; that this bed has gravitated atom by atom, area by area, over and over again; that the water resting on the solid surface must have sunk with its bed, till the earth has been left in her present condition—one part dry land and about two parts water.

With this position before us, we may briefly consider the conclusion that Mr. Murray arrived at by the contrary theory of an upheaved land and a nearly stationary sea-level. He is reported to have said that "the level of the Southern Indian Ocean is lowered some hundred feet; the bearing of this on the apparent elevation or submergence of land along coast lines is evident, for the level of the sea, to which we refer all heights and depths, cannot be regarded as much more stable than the solid land itself." At the end of his lecture he found, from "many lines of investigation," that we have in the "abysmal regions."—viz., the ocean-bed—"the most permanent areas of the earth's surface," and therefore

there were no large tracts of land, in "tertiary times," on those regions which we call the Pacific, the Atlantic, or the Indian Oceans.

The first point to consider is time. Geologists have divided time into epochs, systems, and groups; but as all run into one another with undefined horizons, no beginning nor ending has been fixed for any division. It is allowed by the upheaval theory that the whole surface of this earth was formed under water. The system now suggested begins in the same way. The difference is that about one-third of the solid has not sunk, but has remained where it was, while the other two-thirds of the body have sunk, leaving their highest points as islands in the oceans. The upheaval theory finds organic remains and water-laid strata on our mountain tops and slopes. These remains are used to fix the group, the system, and the undated epoch of upheaval. They are used, in the system before us, for fixing the time, without date, when the water left its azoic strata some five or seven miles above its present level, and all the organic remains from the palæozoic, the mesozoic, and cainozoic, each in its turn, till it is now leaving on our shores the organic remains of the day, and forming strata of modern dusts or solutions along the coasts of all lands. In the course of time these strata and remains of organic structures will be above the sea-level, not by any upheaval without force to upheave, but by the inevitable slow gravitation of the solid, with the sinking of the water on it, and the consequence of more dry land.

The next point is the stability of the ocean-bed. Under the upheaval theory, some portion of our dry

land is supposed to have been formed under water. Much of this has grown into mountains and plains, with raised terraces on the coasts, all in slow, unseen, unfelt gradual motion. The upward movement must therefore be constant, uniform, and under a fixed law. Now all this raised-up land was a part of the ocean-bed; if it was upheaved, there was no stability in it. The gravitation of solids is allowed on all sides; there is no reason why the whole solid of this earth should not sink, except that a larger circumference cannot fall into a smaller; a very natural proportion of about two-thirds has gravitated to its centre. Mr. Murray has pointed out that there are signs of upheaval in the faults, cleavages, and fractures on or near our shores, partly because new deposits and heavier weights are left there. He did not tell us that these new deposits were more liable to the atomic gravitation than old ones, while they must be constantly sapped by the waters running through or below them, or that by these certain actions all the results that he assigns to unproved causes must ensue under natural laws. By his own showing, the ocean-bed is unstable near dry lands, and we know of no exception all round why general gravitation should not go on in all quasi-solid matter; there are no strata without air, gases, or water in them; these move by pressure as well as by inclines, so that solids must be constantly gravitating. It may be allowed that this is very slow now, as our highest authorities call the earth solid; but it is still sufficient to cause an unobserved sinking of the waters, with an indefinite leaving of dry land. There is, in fact, no fixed or stable area anywhere on earth;

areas that have sunk are most likely to go down again.

With the unintentional assistance of Mr. Murray as an advocate for stability in the bed of the ocean, it has now been proved that the entire surface of this sphere was once covered with water, and that the whole is unstable. With this condition before us, we may briefly consider the condition of early dry lands over the areas of our present oceans.

It has been shown by recent geologists that mountains in America were once three or four miles higher than they now are;[1] our British highlands were some two miles higher, and we may infer from these facts that the whole dry land was at one time much more extensive than it is now. By the natural formation of the solids under the dominion of light, the entire surface must have been laid down in undulating plains with more even surfaces than the soundings of the *Challenger* exhibit to us. The currents of the ocean were more free, the eddies were not so frequent, when there were no obstacles, as they became when dry land opposed the great streams of surface warm water to the poles, and subsidences below offered abrupt precipices to the undercurrents from the cold to the warmer regions of the sphere. When there were fewer eddies, the deposits of matter by the waters were more uniform, and, therefore, the entire ocean-bed was more level than it is now, when frequent interruptions turn the surface and undercurrents aside. These causes for eddies must have com-

[1] See Powell's "Geology of the Uinta Mountains."

menced in very early days, and the ocean-bed necessarily felt the forces as they are felt to-day. With the assistance of winds and waves, banks and ridges were formed below water of varied size and varied form. As the bed subsided here and there, the general water-level sank with it, till the highest undulations were left as dry land. Under a tolerably uniform action of wind, wave, and current these undulations must have been extensive, and the present mountain ranges are all that denudation has spared to give evidence of early formations. We find some of these in the silicious rocks on our highest mountains, and remnants of these earlier structures are found in the Sarsen stones, the great water-rounded boulders found in many regions similar to those that have been used in constructing our own so-called Druidical temples. We may also trace the early meteoric dust in our basaltic[1] formations all round the world, and put down these original structures to waves or currents. As these materials can be melted and cooled without changing their general character, this origin does not disturb the opinion that some of our present basalt has been formed in places by volcanic action. This is all we need say of rocks to prove the former existence of higher land. On considering islands all round the globe, we find steep and shelving coasts, the sea may be shallow on the one side, deep on the other; these conditions may be due to subsidence or water erosion on the latter, and to filling up by denudation on the former; both give evidence of prior more extensive lands.

[1] See "Nordenskjold."

We may now glance at the biological evidence for the same condition. Every now and then the remains of great extinct animals are found on the ocean-bed amidst sunken forests or submerged dry land. Similar remains are occasionally dug out of our limestone caves. It has been supposed that hyenas dragged entire skeletons or the broken bones into these caves; but these beasts do not dine in their bedrooms. In the days when they first lived in Great Britain, this land must have been connected with the European Continent, and through this with Africa and Asia. The great beasts must have come from larger and warmer regions, they could not have been indigenous to so small an island; they increased and multiplied till they spread over the whole area of dry land, and so they travelled into Italy, France, Germany, and England. These remains belonged to creatures that died, as wild beasts die now, by the river side or on its dried-up bed. When a flood came, carcasses or skeletons, or gnawed bones, were carried down, rubbed and broken on their way, till they were lodged in their mausoleums of limestone which they themselves had helped to build. Animals were many, man the destroyer was not there; the washed-down remains formed dams here or there, the failing flood left its débris over them. This burial may have happened beneath the sea, or the land may have subsided, while the limestone rock was building over them. These formations are tenacious and adhesive; they took their shape from the buried mound, and, as the remains decomposed and became compressed, the caves were formed as we find them, some with, some without, any signs of entrance or exit

for a running stream. If a stream ran through a cave, it brought in the black earth that sometimes covers the old bones; and if no water ran through it, it percolated the cave roof, leaving the stalactites for our admiration, and hermetically sealing the remains with stalagmite till natural denudation or the curiosity of man detects them, and he lavishes his ingenuity in imagining how such heterogeneous collections came there. In whatever way that happened, they give evidence of more connected dry land. This is put more fully in Appendix B.

If we look at the great Indian Archipelago, we find some islands produce Asiatic flora and fauna, while others have Australian types; both tell of dry land travelling, of more extensive areas, and local subsidence of the surface. We thus find evidence all round the earth of large land areas; the islands all belonged to the ocean-formed undulations, excepting those ejected by volcanoes; yet these ejections prove the presence of earth-produce, and the possible high level of the surface, where the eruptions took place. Under the system now suggested, the highest undulations became the first dry lands; as the waters sank slowly and surely, these grew higher and higher from the sea-level, our measure of height; but though each fossil and each stratum is a measure of time, we have no dates for the deposit, or for the beginnings of the creation, and cannot tell when the subsidences took place that allowed the water to separate the land that it had left behind into islands and continents, while itself followed the subsidences of its own bed.

Our own dry lands are growing now, and decreasing here and there; this action has been going on before and

from the moment this dry land was left, and must go on while there is the solid above and the liquid below. We may come to an equilibrium some day; but at present the highlands give their tributes to the rivers, they pass them on to the sea, and the sea deposits them. Dry land has thus grown where it was not, and it has gone from where it was; but the probabilities are that, when the dry lands first appeared, their surface was more extensive than it is now, and that the islands all round the globe are only the remains of that surface, while all the rest has gone into the ocean-bed.

From all these points there can be but one conclusion, that the present dry land is, because the ocean-bed has sunk, and the ocean with it.

SECTION XIX.

THE OCEAN-BED SCIENCE.

Before summing up the evidence of a subsiding bed and a sinking water, it is well to put before scientific readers the impression made upon a thinking man by comparing modern geological teaching with natural facts. Mr. J. A. Froude, in "Oceana," page 115, asks:—"How many times must we outsiders learn our science and then unlearn it? Each generation of philosophers laughs at the conclusions of its predecessors." We can answer the question briefly. The learning and unlearning must go on as long as the dogmas of science have no foundation. On the subject before us, at page 263, he wrote:—"The road followed the line of the Waikato high above the broad valley which the river had scooped out for itself; it was evident from the series of flat terraces which we saw on the opposite side that there had been a series of lakes through which the river had run, and that at successive and apparently sudden intervals the barriers had been broken through, and the lake levels lowered 40 or 50 feet at a time." These terraces were supposed to be due to earthquakes; "but the uniform and strictly horizontal character of the terraces indicated to me less

violent methods." It is pleasant to find a careful observer forming conclusions similar to those of one's own long practical views. It must be the certain sinking of the water that leaves its own constructions behind it time after time; there is no occasion for any upheaval by an unknown force, by contraction from an imaginary cooling, or by the theoretical action of one area going down and another going up. With this preface we may now sum up the previous letters.

No. 1.—Mr. Murray supposes that land has been upheaved by the secular cooling of the body of this earth, without knowing that it was ever hot. Sir C. Lyell advocates upheaval by lateral pressure, and then finds it is not proved by facts. Mr. Murray theorises on broken masses as evidence of imaginary upheaval, but certain subsidence produces the same result. Time, as given to the world by science, is proved to be an error by their own figures, and, as far as man knows, this earth may be much older than one hundred million of years.

No. 2.—This earth is said to be cooling from a once heated condition, as suggested, but never proved, by the French astronomer, Laplace. He never accounted for air, water, or solids, from his nebulous mass, while light, acting on such a sensitive mass, must produce all three.

No. 3.—The present surface of the earth is composed of her own productions. Marine relics are found on high mountains and in deep mines, while dry land produce is found far below sea-level. How came they there?

No. 4.—Light, as the creating agent, caused evaporation from the nebulous mass; as gases rose, the solids,

as the less sensitive matter, were left behind, while the dust from the evaporated gases fell back to its body, either with the rainfall, or by separation from the air by cold pressure. As the air became rarefied, the whole mass revolved and rotated in the ether of space without friction. As constructed under the direct influence of light, the atoms and areas were constantly gravitating, as shown by the contortions in the sedimental deposits. Coral islands and coal mines prove the contraction or subsiding of the ocean-bed.

No. 5.—Volcanoes evidence of contraction, fire, light —the energy always temporary. Life began with light; the refuse was carried to the waters; similar forces moved and deposited similar materials. Their sunlight was buried with them. Friction, pressure, or chemical action may ignite these deposits. Material is ejected, the foundations are sapped, and contraction ensues. The same happens in earthquakes with or without volcanoes. Both may happen on the ocean-bed. Light was the first cause of growth, deposit, volcanoes, earthquakes. Therefore the ocean subsided, and the marine relics were left.

No. 6.—Denudation, degradation, subsidence, and deposit explained. Evidence of gravitation in secondary formations. No upheaval required, though apparent examples are found high above sea-level. Formations of fallen solids cemented under the sea, but left to become dry land as the ocean subsided.

No. 7.—Professor Geikie makes the deposited matter of this earth 10 or 12 miles thick, with changes in it which, he thinks, are due to the rising of the land, not

to the sinking of the sea. This has not altered its level much. The evidence fails to establish the dogma, and the general condition of his sea beaches proves the sinking of the ocean. Beach, shells, and solid formations are now where water left them many thousand years ago; the dogma of Mr. Geikie is reversed by proofs of sinking all round the world.

No. 8.—*Knowledge*, March 1, 1886, recognises geological fallacies as to heaving up of mountains; these belong to exterior actions. The strata of cretaceous system tell of a deepening sea bottom. Science ignores long persistent actions of wind and water on long-continued ripples. Evidence of these all round the world, specially on the east coast of India. Fallacy of interior fluidity by heat ended. But, notwithstanding their own facts, men still adhere to the upheaval of land without an available force. They ignore the sinking of the ocean, while they accept the certain sinking of its bed, and see the relics left behind.

No. 9.—The irregular sinking of the ocean-bed—Sir C. Lyell on uniformity and law—no evidence in his time of change of sea-level in any region. There was, and there is, evidence of sinking, but none of forcible or imperceptible upheaval. Sir C. Lyell thought that water must have disappeared by a sinking sea; this was not necessary, as breadth was changed to depth. Subsidence irregular as to size of areas and times of action. Mr. Hughes on fixed sea-level, shows land now 1800 feet high that must have been under water to get its deposit; and he finds much error in the evidence of submergence and elevation. The law of gravitation has

made the surface earth what it is; the subsidings may have been spasmodic; the sinking of the sea-level must have been slow and imperceptible, but each sinking gave more dry land.

No. 10.—Previous sections prove non-upheaval by interior force. The whole earth was once the ocean-bed; as this has gravitated, the water has gone with it. Mr. Murray thinks there is more dry land now than ever—time considered, but all geological epochs are undated—gravitation going on, and therefore land must grow. Stability of ocean-bed very uncertain, areas once sunk liable to repetition. Mountains were much higher than they now are; their denudations have built up all the area between themselves and the sea. Eddies and whirls were less frequent when there were no obstacles to the regular ocean currents. As these increased, the deposits were left in more varied forms. Present mountains are remnants of these deposits. Biological evidence of more extensive dry land, vestiges found on the sea bed, in caves, and in other places that belonged to animals of larger regions. The Indian Archipelago, giving Asiatic types in one part, and Australian in another, indicating connection with two continents. Present islands and continents result from the subsidence of local areas. Land increases and decreases, while there is solid above and water below. Conclusion.—Present dry land is due to the sinking of the sea, and is chiefly formed from the productions of land and water under the action of sunlight.

SECTION XX.

CONCLUSION.

THERE is a difficulty in finding an end to a circle that has a chaotic beginning. Since the Mosaic abstract system of Creation was put before mankind, many theories have been invented, and many amendments have been suggested to improve, or to do away with, that hitherto incomprehensible doctrine. The simplicity of the system has been a stumbling-block to philosophers occupied with abstract laboratory experiments, and with the present complex phenomena of this earth before them. Yet, theory after theory has to be given up, while "God said, Let there be light," still stands before us as the truest but misunderstood beginning of this earth. Long before Moses lived men accepted fire as a symbol of their God. Nations keep their lights for ever burning as a reminder of His presence, and they fall down before Him at sunrise and sunset, and light a lamp for departed heroes or lovers. There are many who believe the simple words of the Bible as all-sufficient; but others are still inquiring, how can this be true? This question is at the root of all doubt. We may infer that it led Laplace to imagine

his nebular hypothesis with a liquid fire world. This was supposed to clear up many doubts which existed about a hundred years ago on mundane subjects, as well as on geological matters. The new theory was accepted by men who were called the Plutonic School, while it was objected to by others who were called Neptunians. The logic of the latter was too liquid for the flame of the former, who claimed the victory of words, though no facts were proved. The whole question is, therefore, still an open one, and these brief sections are written with the hope of throwing some light upon it. We have shown how impossible it is for this fire physical science to meet natural facts; and we may now point out how impossible it is for this theory to meet the first step of the Mosaic doctrine, while that step, directly or indirectly, supplies to our comprehension the laws of, and the causes for, those important phenomena that have been touched on under their different heads. Before summing up, however, there is some recent half-scientific teaching to be remarked on, and in doing this we remember the sage advice given by Dr. Jackson—"Take heed you measure not your love of truth by your opposition unto error, for from this arises hypocrisy, hardness of heart, and uncharitable censuring of others." The step referred to has been put before the world by a lover of truth; many have used it before, and frequent repetition makes a false theory appear as true. "Moses and Geology," by Dr. Kinns, is referred to. He begins by accepting the "nebular hypothesis" as true, as "the only probable, and with our present knowledge the only possible, explanation of the cosmical origin of the planets

of our system." It was explained by me in "The Beginnings" several years ago, without contradiction, as far as I am aware, that this hypothesis could not be trusted, yet this year sees the sixth edition of a book that has prelates and Churchmen of high degree amongst its subscribers.

It has been already pointed out that modern science fails to find the facts thought of by Laplace. There was no foundation for his fire world. They all know that light must have existed before this earth was created. Dr. Kinns allows this fact; but Laplace made all his worlds before his sun consolidated from the molten ideal nebulous mass. Nothing is said of fire in the Mosaic record of creation—"God said, Let there be light," and forthwith this earth began to be. That light was the pure eternal light of life, the light of creation which exists all around us and in us; while the fire world of Laplace was the destructive element similar to that which boils our water, expands our steam, and makes volcanoes; or, as the French astronomer thought, expanded the nebulous mass, from which his worlds were to be made, and then his sun, into a fire-revolving body of more than sixteen thousand millions of miles in circumference. Laplace never knew how his ideal heat was gained nor thought of the cold for the coming consolidation: he had no primary centre to give order to his mass. Worlds were thrown off accidentally by centrifugal force from the mass; and then, when all the worlds were made, and the centre mass consolidated as a hot sun, he had nothing else to depend upon for his creating glory than a destructive fire of an admitted tem-

porary nature. Dr. Kinns adopts the finite instead of the infinite; and, while good-naturedly endeavouring to fit much false geology into his own interpretations of theology, forgets that the Mosaic creation of this world was done by God's light alone, acting on materials sensitive to it, all gathered into order and unity, and forced by love of light into that orbit which has been maintained by earth herself, and all the other known planets of the system from the moment of their creation till now. It was pointed out above that Laplace never accounted for water, neither did Moses. It was taken as a thing of course—"God brooded on the waters." Dr. Kinns is curious on the subject; he imagines a globe of fire, but gradually those lurid flames would subside, and then the water (we are not told how it got out of the fire), having given up to these metals its oxygen, they would become alkalis and earths. (He does not tell us what became of the water.) The hydrogen being set free, however, would again unite with the oxygen of the atmosphere, and as a highly heated vapour would ascend to the top, where, coming into contact with the glacial regions of space (we are not told why space was cold while the sun and worlds were hot), it would be condensed, and fall again to the earth. But as time went on there would be no conflagration, for on coming into contact with the still heated rocks the water would reascend as vapour." This complicated, unnatural, and incomprehensible making of water went on till, the earth becoming cool, "the waters would settle down and form a universal ocean, boiling and seething, and assimilating all the soluble matters of very diverse natures.

—(a sort of witches' broth). By degrees the gases in their turn would be dissolved in the ebullient flood." It is not explained how water or matter existed, while the gases were still as they were; neither are we told why the waters boiled on a cooling earth. The witches may have managed that. Dr. Kinns, however, in his bias for a fire world, is quite undismayed at the lawlessness of his elements, and tells us: "In fact the globe would be a mighty cauldron, where the Divine chemistry was elaborating the materials of its ultimate condition amidst lightning flashes and loud-continued thunder" (p. 73.) Neither nature, Moses, nor true geology ever gave the outline for this chaotic source of water.

In June 1883, the *Contemporary Review* contained a paper suggesting that all inquiry into nature should be conducted with a bias—that is, if "certain propositions be taken for granted, we can from them deduce other propositions, so that there may be proof in the middle," though not at the ends. It is from individual bias that we have so many views of the same thing. Professor Croll wanted a date for his glacial theory, and so put a limit to the infinite imaginary heat of the sun. Sir C. Lyell attempted to prove a general upheaval of the earth by ideal fire inside it. He failed to do so, and half repented of his theory near the end of his useful life. A page or two might be filled with the names of those who have written books to explain and expand the fire world of Laplace. There is more to come on this point from science explanations of a later date. It is from this false bias that the entire system is proved false. There were men who followed nature some years ago, but a

sun of light and a water world have been lost sight of in the sensational bias to a fiery universe. The spectroscope has added to the fuel by exhibiting vapours in the sun similar to those made artificially by heat. It has been forgotten by those who have used this fact as evidence of incandescent vapour and a hot sun, that gases may be liquefied and solidified by cold pressure. We know of the cold, but of a fire sun or a fire world we know nothing. In this certainty it has been our object to return to natural laws and causes.

The Rev. James Miller taught us long ago: "The globe which we inhabit, and all its kindred planets, revolve in orbits, that embraced common power in the centre, animating and regulating their motions, on the influence of which their internal energies evidently depend. That we may not be lost in looking for it in the boundless regions without, our great physical power is all within, in the bosom of our own circle, like the light of life in our own bodies." Our centre is our light of life, and light is the only fact we know of. The love of light is the only power we know in and on this earth, which regulates its motions and animates its system. It is this light which gives life, a light which all creation loves, because our mother earth, in her wondrous trinity of solids, water, and air, was sensitive to it in her parts, and clung to it as a whole. It is this light which she absorbs, and gives it back as warmth to the produce of her bosom. It is this light which draws up her vapours to renew her energies with rain. It is the absence of this light that gives nature a rest from her labours for a time.

All this order, uniformity, and love are within the

earth and in all her productions. It may be in all the other planets, moons, and asteroids, and if so this entire system finds the common power in its centre sun. We have endeavoured to trace from the vast book of nature how that centre derived his power by the aggregation of luminous gases, all the light of life, the attribute of our God, and how that aggregation still continues from His worlds of love.

All these worlds were reduced from chaotic wandering masses into the unity and order, which we see moving continually in their own orbits round their own centre in the boundless realms of space; this space occupied by other suns and other worlds with millions on millions of our miles between them, forming uncounted systems, rolling round in that infinity incomprehensible to finite man, who finds a difficulty in understanding the phenomena of his own small sphere; yet all the systems retaining, as far as astronomical history goes, their own order, their own motions, and their own stability in the universe, each system and each world giving evidence of one Ruler over the harmonious whole.

We have ventured to contemplate the action of this rule in reference to earth. We find a sensitive nebula giving out its evaporation, as earth gives it to the light to-day. As some of this evaporated matter returns to the body now, so it did then; while the spirit of light, inherent in matter, was attracted to the sun in an endless circle of its own. From these actions on a chaotic mass, the solid body, the water, and the air became separate, but inseparable, from the whole. There was then the light of life acting on the water and the solids

of life. There was an attraction in these combinations of life for matter sensitive to the attraction. This matter then formed the constituents of organic bodies. And as matter, liquids, and gases continually changed their characters under varying powers of light, and varied combinations of themselves, the bodies formed from them varied in their light of life, in their uses, and in organic forms.

Under these circumstances the original sensitive quality progressed into instinct and reason. Thus vegetation was sensitive to its soil, its water, and its climate. The animal was adapted to its own habitat; it was sensitive of its own wants, the warmth, the cold, and the wet; and what we call instinct provided for its ordinary protection. As this condition went on improving, organic bodies acquired the attribute of a reasoning mind "like unto God," that omniscient power by whom the gaseous nebula was prepared, and made sensitive to His sunlight.

It has been shown how vegetation grew in the water and on land, and then how the moving animal came to live on that annual or perennial growth. All that life was temporary. In death the constituents of each organism returned to the conditions they occupied, before they were attracted to their centre light of life. We had the idea of Sir Isaac Newton that this spirit light returned to the sun. We adopted the same idea some years ago, and the more we think on the subject the more certain it seems that, as remarked above, light must have an endless circle, coming from the sun to vivify matter on earth for a time, and going back to renew the energy of the sun. The material thus constantly given or attracted to organic forms, and con-

stantly returned by them to earth, is supposed now to be locally some thirty miles thick. While all this matter was heaped upon the surface of the solid body, that body was consolidating by local subsidence. The surface of dry land and water subsided by this action, while the winds and the waters moved matter from the dry land to the sea, and sands were blown from the sea to dry land. Bermuda is formed by this action; a long range of sand hills have been blown up on the coast of Holland; and in South Africa mountains of sand have been left by the retiring sea, on the tops of which pinnacles and columns have been formed by the denuding forces of the air. By all these actions together the dry land has grown, high lands have been worn down, and the oceans have increased in depth and decreased in area. As the latter action went on, it followed that the highest areas of dry land became higher and higher, the drainage from these high lands became rivers; they conveyed the waters of their water-sheds to the seas, and thus built up estuary after estuary, till the mountains have been reduced by two or three miles of height, and rivers have grown into thousands of miles in length. By these certain actions the light dusts of the surface were yearly handed over to the seas, to be deposited where they pleased. There are ocean currents, running now over the same course they have used for unknown time. It is to these currents and their eddies that we owe the deposits of homogeneous materials in certain areas. There we have sands, gravels, boulders, all in separate collections; slates, clays, marbles, limestone, chalk, and muds, all in different places. May we not infer from this well-

known mode of selection and deposit, that alkalis and other combustible materials were gathered into the same places year after year in varying quantities according to the supply? Over these natural mines other matter was deposited. The pressure went on increasing, and either by this mechanical action, by the chemical action of water on the alkalies, or by both together, heat ensued, the gases and the steam expanded, and volcanic action took place.

We have shown how eruptions and water leave areas unsupported, with the inevitable result of earthquake action sooner or later. It has been shown how hot springs are due to the passage of water through rocks containing chemical causes of heat; and so fine is the selection by moving water of the material, that I have known several hot springs in India in an area of a few yards, all with different temperature and varying constituents, some rising beneath the cold water of a river. There is a similar condition in the hot springs of Carlsbad and other places, while the cold springs of Homburg, all in an area of some 200 yards in length, give varied analyses of contents. Every spring brings matter to the surface; there is therefore a sapping going on; support is moved away, and the strata above must sink down sooner or later. As the same water-action goes on continually, so the same areas are liable to fall in frequently. Certain phenomena of earth actions have been thus traced to natural causes in her system, all tracing their origin directly or indirectly to sunlight.

When science fails to find a cause for certain phenomena, we have to look for it in nature: we find similar

actions going on; we follow the clue to its legitimate end, and in reaching that source we find the origin of misunderstood actions. The German geologist Werner knew more about the certain action of water than our modern teachers know. These have accepted the doctrine of Laplace, hence their difficulties; Werner followed nature, hence his truth.

In the outline we have sketched in these short sections, every action follows on as a matter of course; each depends on the unity of the whole: the main point is light. Science has failed to find its cause. I venture to suggest a possible, a probable, and a beautiful one, all in harmony with nature, and typified by the circulation of our own blood; it may lead deeper inquirers to endorse as a fact that it is not inherent in matter, that it is the light of life, and God is light: that He has made a sun the factor for our system, and given centre suns to all the constellations, so that all the hosts of heaven are guided by one universal Power. He has arranged the mixture of oxygen, our vital gas, with our air. So much and no more is necessary to maintain vitality. This oxygen-gas is universally diffused, it excites and supports combustion, yet, says M. Cailletet, its liquefaction under cold pressure is a simple operation. Light follows the same system. Nothing on the surface earth is hidden from it; the gas is in it and with it. We do not see it on earth, we cannot see it rising to the sun; we cannot say it does so, but intense light is there, carbon is there, and intense combustion takes place in iron wire, previously heated, when immersed in this oxygen gas. May not the art of the laboratory hint to us the works of

nature? Oxygen is in all life; when liberated from the organic structure, may it not go back in coldness to the sun, and in the presence of the God of light become again a sharer in His glory? Under this idea we wrote—

> "Go forth, My light, and, from the space around,
> Gather the wandering vapours to My care;
> So shalt Thou add their glories to Thine own,
> And fill My kingdom with bright worlds of love."
>
> —*The Beginnings.*

If it is so, if the worlds of our system use the sunlight for a time, and then give back that which gave them their glory to the attraction of the sun, we convert the finite time of Professor Croll from "20,237,500 years" of sunlight into an eternity. We do away with his age of earth under a hundred millions of years, and give it time to do all that has been done. In short, there is an endless circle. We find no beginning, and the ends of worlds will be when they neglect to follow His laws, or when the sun withdraws his light from his constellation.

It will have been discovered by the careful reader from the text and appendices, that:—

1. There is no proof of heat in the sun.
2. There is no proof that this earth was part of the sun.
3. There is no proof of innate inherent heat in earth.
4. There is evidence that light is a distinct force.
5. That this force is creative on matters sensitive to it.
6. This creative action gave causes for igneous action.
7. That consolidation of the body took place.
8. That the waters subsided with their bed.

9. That dry land appeared, and became high above sea level.

10. That earthquakes happen by this consolidation.

11. That the laws of creation have never changed.

12. That the action of light is uniform.

13. That materials acted on must change.

14. That changes of material affect the action of light.

15. That light is the dominant force in the universe, and all the phenomena of earth are under its control by the constitution of the body, its particles, and its gases.

APPENDICES.

APPENDIX O.

Much information has poured in while this edition was preparing. It is arranged here in the order it came. The reader will find that phenomena and facts, as related by theologists, physicists, materialists, meteorologists, zoologists, and cosmologists, have points bearing evidence to the truth of the system as sketched in the text. The first is contained in "Nature and the Bible"—James Davis — published by Messrs. Houlston & Wright in 1866. The following extracts are taken in reference to my system of light and the formation of mountains:—

At page 55, "Every system hitherto advanced has fallen short of explaining the meaning of the first created light." Page 93, "The sun is the primary magnet of attraction." Light (page 100) "gives the world her revolution and her growth." The "sunlight proceeds from a body of fire." Here we are not in accord, but the reasoning of Mr. Davis demands attention. "The sun is the great magnet, attracting supplies of fuel from every orb within reach of his gravitating force." With every ray of light (page 102) imported there is a return of "magnetic fuel." The attraction (page 121) "is incessant, equal, and gradual." The fire is then modified.

"The ray transmitted to us is not fire. Nor can the sensation of heat be felt until the ray be concentrated in a substance capable of absorbing and reflecting it." Light (page 125), when liberated on earth, "assumes the ascendant motion."

We then come to another point—"Geologists are most assuredly at fault whilst attributing the formation of mountains to gaseous upliftings." The formation of them "is not by sudden convulsions, but by constant successive gradations; there is no cessation to this growth." "Earth, air, and water are substances of vitality, brought into motion by the power of light." This continual growth, and all the consequences of the increase of dry land, is assigned to the consolidation of matter and the unavoidable sinking of the sea.

The second comes from "Inquirer" as a pamphlet. As a nameless publication its value is small, but it brings evidence from another direction to support certain details of my system. Materialism is a growing theory, it does away with our Creator; but there are clever, good, and moral men busy with it, whose opinions are worthy of attention, if only to make the other side more brilliant. The pamphlet is dated December 1886. In it I find: "Matter is really an eternal living, active substance;" it is "indestructible," and, as living, "has no need to be called to life" by an act of creation. Ever-living, acting matter obeys "the necessities of its surroundings." Hence cosmic systems have grown, and "by their increasing densities their cold outer crusts continually had to contract, causing crumplings, fissures, subsidencies and faults; occasionally by friction the

evolution of great local heat." This cosmic action meets my system with its inert matter vivified by light. It is then allowed that fire "may dissolve the constitution of matter, but" the material takes another shape, or enters into new combinations in the system of some organism. "There is no superaddition of life to it." Yet all this living matter rolls up into new forms, "interacting with surroundings." With these reasonings "Inquirer" decides the question "that the living is or was got out of the non-living by an act of creation" is "an assumption as truly monstrous in its way as are the dogmata of will, free-will, creation, the soul, &c." Thus, while he is making inquiries, this revolutionary materialist condemns the conclusions of his forefathers, and winds up by telling us that evolution is still equally active as in the past, "giving varied effects of mechanical, vegetative, animal, and mental actions."

Darwin taught us much science while endeavouring to prove evolution; but neither he nor any other evolutionist began without life. "Inquirer" makes his dust alive, but does not tell us how life came, how many atoms made a microscopical Rotifer, how that improved into a gadfly, a mammoth, a monkey, and a man. We cannot get beyond the perception of our faculties; effects must be in accordance with the causes. We cannot lay down dogmas on the mental faculties of the ashes of a cigar, or trace how the smoke vanishes into another form, with as much reasoning power as the tobacco plant had in its lifetime. "Inquirer" must pardon the ridicule that falls on this serious subject. I am not scientific, but a simple student of nature; the

more I study it the less I find known by man, and the more I trace to an omnipotent, omniscient Creator. "Inquirer" puts a case—If a creationist asks, "Whence does eternally-active living substance proceed? he would suggest the counter-query, "Whence proceeds your eternal creating spirit, that after an eternity of inaction at length suddenly woke up to an act or acts of creation?" Who ever thought of inaction under the Creator's light? Who ever thought of matter as eternally active and living without that light?

The third shows the doubt that exists in the minds of astronomers as to the real colour of the sun. Professor Langley puts it down as blue; Captain Abney finds it white, as this extract from the *St. James' Gazette* of February 26th, 1887, tells us.

IS THE SUN BLUE?

A year ago Professor Langley, the distinguished American astronomer, performed an experiment in the theatre of the Royal Institution to explain his startling paradox that the true colour of the sun is blue. He argued that the atmosphere cuts off a large proportion of the blue rays, and that if the observer could get beyond it, these would so predominate that the sun would look blue. Last night, in the same place, Captain Abney, in a lecture on "Sunlight Colours," repeated this experiment, adopting Professor Langley's figures with mathematical accuracy, but dispensing with his paper discs, which this lecturer held vitiated the result; and

he showed that the colour of the sun was not blue, but very nearly that of the white light to be seen at high elevations in a clear, dust-free atmosphere. When the spectra of sunlight on the Alps, and as imagined by Mr. Langley, were compared side by side, they were almost identical. The principle was illustrated by a fine experiment, which Captain Abney called an artificial sunset. Through a solution of hyposulphite of soda, a clear circle of electric light was thrown on the screen. The image was like the sun at noon. Then a few drops of hydrochloric acid were added to the solution. This produced a turbid mixture, and, as the turbidity or muddiness increased, first the violet, then the blue, the green, and the yellow rays were successively cut off; the image varying with every gradation, until finally there was the dull red of the sun setting in a wintry or a smoky sky. The obscuration caused by a London fog, when every light seems a dull red at a short distince, is due to the same cause.

The only observation to be made on these scientific variations on one point is, that very little is known about it.

"The Chemistry of the Sun," by Norman Lockyer, comes as fourth, a laboured work on strictly scientific principles, from which a few quotations may be made. The preface tells us that centuries may elapse "before the ingenuity of man will succeed in formulating the celestial hieroglyphics." The present attempts are divided into three heads, 1st, "The determination of the position of everything which happens on the sun." This is simply impossible, for the surface sun and its

atmosphere are always in motion. 2nd, "To connect these various indications of changes in the sun with changes in our own atmosphere." As both changes are constant, the attempt can never reach completion. 3rd, "This has to do with chemistry." As this point depends on the analogy of earth material, as found in the laboratory, with vapours and colours, as shown by the spectroscope through the atmospheric strata of this earth and the sun,—it has to be decided, in the first place, whether the colours, as seen, are due to colours in the mediums between this planet and the sun, or whether they are in the sun itself. Until this point is certain, "the chemistry of the sun" may be a wrong title. Mr. Lockyer allows it to be "an attempt almost to do the impossible, unless a very considerable amount of time and a very considerable number of men be engaged upon the work."

The law is then laid down that "the temperature of the sun is beyond all definition—the vapours are not confined—there is an enormous number of them all mixed together, and free, as it were, to find their own level." Under these circumstances, with ideal heat acting on all the constituents of the sun, it is by Mr. Lockyer's own showing an impossibility to find a true coincidence between the vapours of earthly matter, heated by artificial means, and the constituents of the sun's atmosphere, whether heated by an unknown cause, or acted on by cold, just as the evaporations of this earth are acted on as they rise from the body towards the cold above us. Certain combinations of matter are used in the laboratory to give out vapours by heat, but "the

spectrum we have observed in each case is not the record of the vibrations of the particular substance, which we put into the case, and with which we have imagined ourselves to be working alone, but by all the simple substances produced by the short and long series of 'separations' effected." But "the so-called chemical elements behave after the manner of compound bodies." —This is natural enough, for as the cold separates the evaporations from this earth, so the cold of the sun's atmosphere may separate its constituents as they continually rise from the body of the sun. The doubts of Mr. Lockyer seem to confirm this view. "For these transcendental temperatures do dissociate, and that therefore what had hitherto been taken for granted is, in all probability, not true." He is however content with what he has done, though not yet "face to face with the whole truth." We may say that he never can be, if he trusts to his transcendental heat.

We now go on to his concluding chapter, xxviii. It is supposed that there is "a true atmosphere arranged in layers, the chemical components of which depend upon temperature only." Each layer will be hotter as it nears the sun, and this body will be "a mass of gas at a far higher temperature than anything outside it." Why so? The atmosphere of the sun must meet the so-called ether of space; if there is a difference of temperature at the junction, there must be a difference of quality; then friction would occur. No notice is taken of this contingency, but "Falls of cooled material must take place in different degrees, and in greater or lesser quantities in all parts of the solar surface." We have the same

phenomenon on earth. But "the effects produced (on the sun) must be on a scale transcending those we should expect from the action of heat on the chemical elements we are familiar with here." It has been shown above that they are not the same things. Mr. Lockyer goes on with most interesting physics; but at p. 434, "So far the phenomena have resisted explanation." The subject is summed up by telling us that "the idea of dissociation is not out of harmony with any known solar phenomena;" well, we do not know that the sun is hot; but the separation by cold pressure would produce similar effects, and we do know of cold between us and the sun. By this cold the evaporations return to the body as dew and rain, &c. These evaporations are not seen, under some atmospheric conditions, till they rise into a cooler stratum of atmosphere; the separation of the liquid from the air gases takes place then; we see the thin white cloud forming, and rising up the mountain side, leaving moisture on the thirsty vegetation of the higher ground, and then hanging over the high land, till the winds move these clouds away. In this dissociation and separation of liquids and air certain solids are mixed up, drops of dew may have a sediment, rain contains some solid particles, and some go on in the air. As mentioned in the text, all of these remnants of solids are separated from the rarefying air by cold pressure to come back to this earth as meteoric dust, or as Laplace told us, to form meteors, that either fall bodily on earth's surface, or burst and disperse in their passage through the air. Geologists have written much on meteorites and meteoric dust as coming from broken-up worlds; but as Raoul

Pictet, and Cailletet, and others have converted air and gases into solids and liquids by cold pressure, nature may do it over our heads in the cooling condition of the air. If there should happen to be an observer in the sun, these movements in our atmosphere would appear very similar to the "falls" in the sun, as recorded by Mr. Lockyer. There are laws for all motion in or on this earth, and while allowing the destructive and dissociating power of fire on the produce of this earth, we know nothing of any produce in the sun, or of any material that could renew the supposed transcendent heat in his body. If however it is certain that this orb of light is formed of, or does contain the same constituents as this earth, it is fair to infer that these constituents have their laws there as well as here. Therefore similar materials under similar laws may have similar actions, and all the movements in the sun's atmosphere may be due to the same moderate variations of temperature as we enjoy. If so, the sun moves in the ether of space just as this earth does without feeling it. If this ether of space is in the same conditions round the sun as it is round this earth, at about "18° or 30° Fahr." (*Nature*, April 28, 1887), then we have a cosmic or universal arrangement, under which all actions are carried on with a unity and a regularity that could not be on any other terms.

Sir William Thomson comes next in *Good Words* for March and April 1887. At page 150 we read: "It may be taken as an established result of scientific inquiry, that the sun is not a burning fire, and is merely a white fluid mass cooling, with some little accession of fresh

energy by meteors occasionally falling into it." He accepts the theory of Helmholtz. "The sun's initial heat was generated by the collision of pieces of matter . . . attracted together from distant space to build up his present mass."[1] Therefore "the sun must be fluid." Two propositions are then made—"Gigantic currents throughout the sun's liquid mass are continually maintained by fluid, slightly cooled by radiation, falling down from the surface, and hotter fluid rushing up to take its place." This coincides with Mr. Lockyer's teaching. We have very similar conditions in a reversed order on this earth; very much the same as if one action was reflected, or that similar materials acted in similar modes under similar conditions. Our atmospheric air is constantly rising warm from the surface of dry land and water, to get cold and rarefied the farther it circulates from the warm zone. The warm surface water of the tropics runs in great currents to the poles; it is there cooled and sinks, to return in constant sub-currents to the tropics, to replace the warm water that is always rising and moving on. There is then a perpetual circulation of fluids or matter on earth and sun. In the latter the motion is attributed to excessive heat, on the former there is no excessive heat. Therefore, as the materials in both are nearly similar, there seems to be no occasion for excessive heat in the sun.

Sir William Thomson thinks any one would be "exceedingly rash to assume as probable anything more than twenty millions of years of sunlight in the past history of the earth." Uncertain figures have been frequently

[1] This system was discussed in "The Beginnings." Trübner, 1878.

placed before the public, without any satisfactory cause for the change. On turning to *Climate and Time*, James Croll, 1875, one of the most lauded physical works of our times, we find at page 327—If we could form a conception of "one hundred millions of years, we should not then feel so dissatisfied with Sir W. Thomson's estimate that the age of the earth's crust is not greater than that." Croll gives that age to the sun, and puts the geological history of our globe at a smaller figure. These "guesses" at the age of earth and sun will continue as long as the origin of both is undetermined.

One of our first physicists informs me privately that the heat of the sun is not fire; several authors on different views tell us that the sun need not be hot. It is pointed out in the text, that sunlight only acts as heat on earth upon materials or gases more or less sensitive to or absorptive of light; the luminous paint when exposed to the daylight for ten hours retains its luminosity for fifteen or sixteen hours without heat. Uncertainty is everywhere. The fire-world, as suggested by Laplace, is rejected by Sir W. Dawson. We require correct data to start from, before puzzling students of natural history by one thing to-day and another to-morrow, thus throwing cosmogony into chaos, and making scientific teaching untrustworthy.

There is no occasion to make remarks on the accidental cause of heat renewal in the sun. Laplace thought of it, Professor Croll calculated it: both results were unsatisfactory. Sir William Thomson knows that all earthly phenomena are due to law. There is no accidental collision going on between comets, meteors, and the sun.

If light is a force of itself, then no renewal of actual excessive heat is required. If the work is done as described in the text, then the supply of light will go on as long as this constellation exists. It has been shown by some astronomer that Jupiter is self-luminous. If the earth could be seen from other planets she must be luminous also: there is no occasion for her to be blotted out of the bright circle of worlds that obey the rule of a centre attraction. The volume of that body is "1,250,000,"[1] and his mass is "318,000" times greater than the earth. Actions in both bodies are similar; may we not take the laws for those actions, with similar material, as comparatively similar? No body in the universe is without an object; there is no accident in cosmic actions. Material all round the system is ponderable, though the molecular process may reduce it to an infinitesimal point; light is imponderable, therefore there is a dualism; but light and matter combine and become ponderable in their unity; dissociation takes place when the matter, as derived from earth, heats or burns; the fire produced by this burning is a force; the light given out by the flame is not called a force, but its radiance may extend many miles beyond the fire force. It has been found difficult to decide which came first, fire or light; as far as we are concerned on this earth, all that grows began with light. Light is absorbed by that which grows; this light is inert, till it comes under one of the laws that cause heat in terrestrial matter; then it can be converted into fire naturally or artificially. As to this earth, the creative light must have existed before

[1] Skertchly, "Physical System of the Universe."

the destructive fire, or there would have been nothing to burn. We may therefore infer that wherever there is life, there must first have been light.

I do not wish to throw any ridicule on so serious a subject, neither can I suppose that Sir W. Thomson intended a joke when he told the Bishop of Argyll and the Isles that he "believed the sun to be built of meteoric stores"—figures of these are given in *Good Words*. Sir W. Thomson knows that no general heat is given to this sphere by the fall of meteorites on it: why then should he assume that his very hot sun was formed by meteorites that could not have existed before there was light, and why should he imagine that the concussion of these atmospheric-formed small bodies should maintain the imaginary heat of the present time?

The annexed letter from the *Morning News* of 23rd March 1887, will show what an independent thinker sees in the late lecture of Sir W. Thomson on this subject.

"SIR,—It must be obvious to all commonplace thinkers, who have read the lecture by Sir W. Thomson, on 'The Origin of the Heat of the Sun,' lately delivered at the Royal Institution, that the most transcendent mathematical calculations fail to add to our knowledge of what the sun really is; but we were helped by this profound and outspoken lecture of our great scientist to know what the sun really is not. It is not gaseous, it is not solid, it is not on fire.

"Well, if it is liquid, all the laws of nature must be reversed up there, because liquids become gaseous at the intense temperature of the sun, molten lead would turn gaseous, and water would soon be resolved into its constituent gases, oxygen and hydrogen; no metal could retain its liquid form at such a heat; then what can the liquid be? Not lava, nor anything

lava-like, for a globe of lava would be several times heavier than the sun, which is only as heavy as a ball of water; besides a liquid body of such an enormous size could not hold together, nor would a molten body give out flames, but rather steam or vapour.

"Sir W. Thomson's arguments have thrown us entirely back on electricity as the only source of the sun's heat possible to conceive. The general impression regarding the sun is that it is a gaseous orb, and it is wonderful how this can be believed, for if a mass of gas was set fire to on the outside it would immediately explode and collapse. Professor Ch. Fievetz says —'Given the high temperature of the sun, its chemical elements cannot exist in the solid or fluid state, or even to any large extent in the condition of compressed vapours.' So we may well ask, what is it? We may indeed ask, but as yet none can answer. Mr. Norman Lockyer, in his laborious quest for the primordial element, may eventually hit on some fresh theory of the sun, but as he is only seeking at present in the 'chemistry of the sun' for what does not exist (an element whence all other elements were evolved), we cannot take him for a very safe guide, especially after his failure to convince the scientific world that the fumes of volcanic eruptions were the cause of the heavy laden atmosphere, which was so generally felt over the earth, and which has turned out to be really caused by snowclouds, the accumulation of which has been in no way accounted for. Imagination might picture the sun as a small solid body with a very deep sea of water surrounding it, on the surface of which fiery incandescent gases could play without consuming it, as lakes of asphalt have been known to burn on the surface, and the continuous heat might be kept up and supplied by gases drawn, as the late Sir W. Siemens supposed, from the surrounding space; but this is a very improbable conjecture, and it is plain that the sun is an electric light, whence proceeding none can tell.[1]

"MARGARET B. ALDER.

"Holywood, March, 1887."

[1] This letter may be taken at its own value.

Professor P. S. Tait comes next. Like Mr. Lockyer, his "main source of light is incandescence;" his cause for it is in "the potential energy of gravitation of scattered fragments of matter." It may be allowed that matter is scattered in fragments, we see it dancing in the sunbeams within our habitations, and in the gleam of sunlight through a thick wood; we know that these fragments are continually falling around us; but we do not know that any heat accompanies the fall. We know that the sun is an attractive body, so is a candle to the insect; but we do not know that insect, or any attracted matter renews the light of attraction. Mr. Tait writes—"When these fragments fall together, as in the formation of the sun and stars, heat enough is generated by impact to render the whole visibly incandescent." If this were a sufficient physical fact, why does the Professor seek for other causes in electricity, friction, chemical affinity, and compression. All of these give heat and fire to certain materials; but light can be produced without them.

Professor Tait helps us to elucidate the subject. I have said that sunlight acts on matter sensitive to it. He tells of the "giving out of light previously absorbed," sect. 26. This is done by luminous paint, mentioned above. He has a chapter on absorption and fluorescence. Sulphates of barium, calcium, and strontium, "carefully preserved from the air in sealed glass tubes, appear brilliantly luminous when carried from sunlight into a dark room," sect. 204. "The colours of this phosphorescent light are of the most varied kind. The causes of this diversity are as yet quite unguessed at." The

luminous paint was a result; there is no heat in its light, and as no physical or chemical change is experienced, this quality of retaining light is "exceedingly puzzling." This is the entire problem of light, and Professor Tait is in the dark. He allows the light of insects, fishes, &c., in sect. 27; but will not discuss the subject, because the light is "physiological." In connection with an organism it may be so called; but the light of the body is a separate essence, in unison for a time with constituents sensitive to and absorptive of that light. Professor Tait does not tell us how light began; and unless science can supply a true cause we may be content, as I have said in the text, with the Mosaic teaching, "Let there be light," as an esoteric truth of divine beauty and love. Professor Tait is puzzled at the changes of colour in the laboratory experiments with phosphorescent light. Is he not in the same condition with beasts, birds, fishes, insects, reptiles, and flowers? All approach more or less to the character of their habitats. We shall see their use in Appendix C. His colours are in his air, and are dependent on their individual sensitive qualities in regard to light. The same variations are found in man's mind; I have put several scientifics together on one subject—they all vary. No two of them are formed of the same constituents; all have the gift of reason, but the sunlight is not accepted by all in the same degree. Therefore they vary with the same beautiful precision that the spectrum exhibits in the lines of the sun on earth's atmosphere. Is there not room in all these variations of opinion for some consideration of the subject now placed before the world?

The postulate is simple, "God is Light," and "Light is life."

Nature, of March 31 and April 7, 1887, lends a touch to this Appendix, contained in a lecture by Professor T. E. Thorpe, on the constitution of matter. Atoms and molecules are mentioned in gases, solids, and liquids, as "dependent upon atomic and molecular mobility." For "the atom possesses always more or less motion, due, it must be assumed, to a primordial impulse," and "the action of an atom as one substance taking various forms by combinations unlimited, was enough to account for all the phenomena of the world." Mr. Thorpe goes beyond the Epicureans; they taught of atomic motion in reference to sensual action, but neither Epicurus, Leucippus, nor any one else tells us how this "*primordial impulse*" began.

It will have been understood from the general context of this work that no impulse or motion tending to creative action could have commenced till there was light. It is of no consequence here whether there was one gas or a hundred gases—we may accept the nebulous mass of a beginning as containing gases sensitive to, absorptive of, and convertible into, other bodies of light. The action goes on before our eyes, and those eyes that cannot see them may be composed of those atoms which have a "primordial impulse" from an unknown cause. If then, as the Materialist is teaching us, man is formed from accidental living atoms containing his life, his brains, his soul, and senses, leaving out his conscience, the doctrine leaves the human race in a worse condition than the ant, the bee, the swallow, the mole, the bear, the salmon, and all those creatures that exhibit to us

their actions of free-will. Therefore, if the Materialist is right in his teaching, all the rest of us are working uselessly, for as we too are composed of the same materials they cannot by any possibility be acted on in a similar manner by the same sunlight. Under these circumstances all that has been written on this subject for some hundred years may be put down to waste (brain) atomic force. Still every new light upon atoms will give them new qualities, possibly some truth.

APPENDIX A.

BONE CAVES.

THERE are certain caves in Great Britain, on the continent of Europe, and in other parts of the world, in which the floor is full of bones, in varied conditions, that once belonged to the herbivora or carnivora. These bones, said Cuvier, "were evidently interred in the same manner and by the same agents." He then said—"There are but three imaginable causes by which such vast quantities of bones could have been accumulated in these vast subterranean repositories." They are the remains of animals which lived and died there, or they were carried there by inundations. Cuvier objected to the latter, because of "the integrity of their smallest prominences." The floor of these caves is sometimes covered with diluvial loam and pebbles, under which these bones are found "in a state of preservation by this covering and the coating of

stalagmites." Dr. Buckland taught that the bones were brought in by hyænas that lived and died in these caves. This is the blot in natural history. To prevent any confusion, I divide caves into three heads—First, those that have been excavated by man or beast; secondly, those which have been washed out by water; thirdly, those that have been built on a centre or nucleus. With the first I have nothing to do here. The second is well known to science, and is made by the running of the rainfall into lime formations. The commencement of this wash is sometimes seen in swallow holes. The water is collected from various slopes, and, mixing with vegetable acids, saps the limestone rock below. The channels made by this wash are small or large, and run through the rock for short or long distances. In these channels cavities may be made, and material brought in from above may be deposited in these chambers. Light material, such as diluvial loam and rounded pebbles, could not stay where there is an occasional rush of water. Entire carcases of animals are now sometimes rolled down the slopes of the swallow hole into the water channel. The sides of the swallow hole slopes are often good pasture ground, so that, in dry seasons, the herbivora resort there, and, if there are carnivora, they follow the throng. There is, then, a natural reason for the deposit of carcases and bones, in worn or unworn conditions, in these subterranean cavities; and, while such causes must have existed, even since the water hole began, there is no reason to attribute their presence in the caves of such rocks to any other cause.

The third cause for caves must now be considered.

They are built as a nucleus on a centre support, and are similar in history, but not in extent, to those coal-fields which have ocean deposits over each seam. We may go back to those days when men were few or none, when animals increased and multiplied, with a dry highway from tropical regions to these latitudes. The seasons varied then as now; there were wet and dry. In the latter the beasts of the field gathered to the usual surface water runs; they died there, for there was no water. Mountain glens and valley beds held their carcases. Vulture and hyena revelled in their feasts. They eat while life lasted, but the carnivora die in droughts as well as the herbivora. When the rain came, bones broken and gnawed, carcases more or less torn, some fresh and some dried up, were all rolled together down the flood. The bones in their skins were entire to their smallest prominences, those unprotected might get rubbed in transit; but those who have seen a yellow flood rolling down in a great river know that such materials seldom touch the bottom of the river till its force abates and they are deposited. Like forces deposit like material. When the estuary is reached there are holes and eddies; mud is left in one place, sand in another, gravel here and pebbles there, but carcases and bones drop down together. A mass of animal matter is heaped up, alluvial loam and pebbles are left over the mass; the tide flows, and its lime solution settles over the nucleus of the animal remains. This covering is self-supporting, every tide adds to its strength, the area may sink, as coal areas have sunk, till a great thickness of limestone is formed. The heap of matter below becomes decomposed; the alluvial loam or mud presses it together,

the heap sinks, it is flattened down by the stalagmite that runs down from the new-made limestone, and, as it sinks together, the self-supporting rock has staid still to form the cave. No water ever ran through this cave after the first covering of soil and lime was laid over it. No hyæna was there to drag the bones into his den; all in that region had died; and all in that valley were either buried in one vast mausoleum or had their bones ground into solutions to make the winding sheet and preserve their friends in a recognisable condition. A word more about hyænas. It is hard to say what was fashionable in those days, but in the present these scavengers do not take bones into their dens. I have been in many without finding a single bone. Men have thought that hyænas lived in these bone caves because their excrement has been found there. When any beasts of prey feed on bones their droppings are calcareous, hard, and light. When dry they float. The calcareous excrement that has been found in caves may be of the hyena, but it is no evidence that he lived in the cave. Dirty feeder he may be, but he never dirties his den in the way supposed. As there are natural reasons for the collections of bones in both cases, it is as well to blot out from natural history the ingenious, unnatural ideas that have been entered in its pages by clever men, and continued by those who pin their leading strings to the aprons of those who wrote before them. There is no truth in the tale that hyænas dragged the bones into those caves where we find them in vast quantities. They were placed there by one agent, water, and found when natural denudation or man's demands opened up the old mausoleum.

APPENDIX B.

A REVOLUTION IN SCIENCE.

THE address of Sir W. Dawson to the British Association is the most important to the science of cosmology and geology that has been given for many years. He warned his audience that "the new philosophy, like those which preceded it, may meet with very imperfect success." He allowed that we have no means of "exploration in the earth's interior," and then said that "the labours of physicists and geologists have now proceeded far enough to enable us to make some personal affirmations with certainty." These are:—1st. "It is evident that the crust on which we live must be supported on a plastic or partially liquid mass of rock." This starts the new theory. 2nd. The earth body is believed to be "solid, of great density and hardness." 3rd. The condition of fusion "arises from the action of heat on moist substances." This interior crust is partly silicious, partly metallic. When fissures occur, "The lower crust is forced up, giving rise to volcanic phenomena." 6th. "The contraction of the earth's interior by cooling, and by the emission of material from below the over crust, has caused this crust to press downwards, and therefore laterally, and so to effect great bends, folds, and plications; and these, modified by surface denudations, constitute mountain chains and continental plateaus." The old theory is disposed of in certainty No. 1. The similarity of volcanic action "led to the old idea" of a fluid interior of the earth; this is now generally abandoned, "and the interior heated plastic layer is regarded as merely an under-crust."

If, then, this under-crust is kept in a plastic condition

all round the world by the perpetual heat and moisture, why is it not perpetually forced up by the perpetual pressure? There is no reason why a fissure, once opened by this arrangement, should ever close up. The layer is composed of metal and silex. The lava forced up by volcanoes is chiefly silicious. There may be metal in some volcanic rocks; but as it is easier fused than silex, why is it not sent up in streams, if the eruption is due to pressure? Leaving these questions to be answered, we may now run back over the certainties. The mountain chains, as we find them, are so formed by denudation. The continental plateaus are all formed from the waste of the high lands, from which our mountains are formed. Here we get Sir W. Dawson to help us. "This leads us to the further consideration that while the ocean beds have been sinking, other areas have been better supported, and constitute the continental plateaus." Then the thickest deposits are in the areas of these sinkings. There "the most extensive foldings and the greatest ejections of volcanic matter have occurred." Now all these deposits came from denuded land. They all had to settle down by natural gravitation; they were all soft, they formed bends, folds, plications, and faults in the process. Sir W. Dawson has done away with the innate heat, as the legacy of Laplace, by which all the contracting process has been supposed to be done; his own hot magma is unproved, unnecessary, and unnatural; there is no cooling required. The ocean-bed has sunk some 10,000 feet (Dana); our coal-fields have sunk to some 4000 feet, the ocean has buried them time after time. These sinkings of the ocean areas fully account for our highlands; the sea is still sinking, for every ocean earthquake means a subsidence of its bed. We may leave No. 2 alone as a quasi solid body now, though it was once a cold nebulous

mass; but as to certainty No. 1 there is not now, and never has been, any need for a hot plastic layer of matter anywhere beneath the surface on which we live. If the surface of the nucleus is hard and solid, the deposits on it are comparatively soft and permeable. The rain-fall runs through these, and under them; moving water is a force, sapping and mining goes on, the deposits are always gravitating by particles and by masses; when a fall takes place in a combustible deposit, gases are liberated, heat ensues, steam expands, and, dependent on quality and quantity, explosions and eruptions take place. This constitutes the volcanic earthquake and the eruption. When sapped deposit falls in an incombustible deposit it is the common earthquake.

It is not said who the geologists or physicists are who have guided Sir W. Dawson to his "certainties"; but as far as the public reader knows, all the latest text-books, lectures, and teachings of modern geology and cosmogony are founded on the nebular hypothesis of Laplace. He gave us the fire-born world; it has been objected to by some from its starting point; some have written against it lately, to be met with sneers. Sir W. Dawson now says it is "generally abandoned." I venture to hope it is, for for a greater false theory never existed.

This revolution has been expected; but the new "philosophy" was not thought of by those who trace natural effects to natural causes. The sequel to this giving up of the fire-born world is extensive. The elevation of mountains by the contraction of a cooling body, the heat in mines and wells, hot-springs, mud ejections, volcanoes, earthquakes, must all be assigned to natural actions. Sir W. Dawson ends his valuable address by confessing that there is still much to unlearn and learn. Will he take light, not heat, as acting on gases and matter more or less

sensitive to it? We see the effects of light to-day; the laws have not altered; if we trace them back, their light attracted a wandering nebula to himself, gave it the orbit now enjoyed, so that no part of our globe, or of other spheres, is hidden from the light of life. This has been suggested for some years, and now that the old system of creation, as dependent on destructive fire, has come to an end, can we do better than adopt creative light?

APPENDIX C.

"LIGHT, THE DOMINANT FORCE OF THE UNIVERSE," by Major W. Sedgwick, 1882, has been reserved for the conclusion. He is a little bound by the fashionable school, but is valuable to enquirers as an independent general thinker; he is useful to me, as reaching the same point by another route. Sir H. Davy is referred to in his preface as pointing out how "bodies exist in different states, and these states depend on the differences of the action of attraction, and of the repulsive power on their corpuscules." Davy thought that "light was a body, and as such could enter into chemical combination with oxygen." Sedgwick tells us (p. 8) that light as the compulsive force "holds in its grasp and connects together every particle, every mass of matter, and every one of the heavenly bodies in the universe." In the act of penetrating a body, light forces a passage by "displacing repulsive force." This is heat—"produced by the direct repulsive or expansive actions." Heat and light travel by a wave motion; they "are generally found together" (p. 173), but "are opposite and not identical in character." This is repeated at p. 184; at p. 194 he found what he

supposed to be "proof of the accuracy of the view, that light represents compulsive and heat repulsive force." Here a remark is due to Major Sedgwick. If, as he allows, and as I have shown all through the text, light is the first force and the first cause of action in this sphere, and if, as he allows, light has the power of penetration by displacement, then the material so displaced was moved by the action of light on matter more or less sensitive to it. This movement of particles created heat. All the particles that acted as obstacles to the progress of light were expanded and dissociated; the solid body or mass was no longer in that condition, it could not repel or obstruct light. Repulsion seems therefore a wrong expression for any substance over which light has sway, for this sway gives the heat by its effect on the particles. Where matter does repel light, it need not be hot; therefore heat is not repellent of, but an accepter of light, as far as the elements of this earth are concerned.

We now come to an error of fashionable theories (p. 199). "Heat rays can be refracted in precisely the same way that light rays are refracted; accordingly we find light and heat rays brought to the same focus with a lens." If ordinary light does what Major Sedgwick says it does, as we shall presently see, then there is no occasion for the refraction of an independent heat ray, because the focus of light, being much stronger than ordinary light, exercises more force, moves more particles, and produces more or less heat according to the object on which the lens acts. This view is partly confirmed by the Major at p. 209. Light acts differently on different colours; therefore "every spot and mark on hair, feather, scale, egg, leaf, flower or seed, has its peculiar use" in elaborating the secretions of the kind. Thus these marks are not repulsive to light, but are guides for it to act in a way

suitable to the object acted on. Again, p. 225, "growing stems or leaf stalks which receive a much greater amount of light on one side than on another, curve towards the side exposed to the more intense light." Thus the light acts on vegetation as a contracting force, and the sap expands more freely on the other side.

At p. 279 Major Sedgwick says he has tried to explore new paths while the old "landmarks have been in sight," "and they are in sight now at the close if we would but open our eyes to see them." Many of those to whom I have referred in these pages have seen the landmarks, and have passed on to their own goals without remark. So it is always; our own conclusions are formed on *malice prepense*, and our eyes fail to see the true lines of evidence. The amateur philosopher, however, has kept his eyes on light, and asks, "What is this compulsive force, with which every particle, and every mass, and every body animate or inanimate, is begirt, and being thus begirt, is compelled to take its appointed place from time to time, in group, or cell, or crystal, or mass, or body, in solid, in liquid, or gas, and to move into its place always in a perfectly orderly way—but a manifestation or an expression of the will or power of God, omnipotent, omnipresent?" Old myths are then brought on at p. 280, and the author asks, "What is this repulsive force," which in like manner pervades the animate and inanimate, endeavouring "constantly to escape from the positions into which it is brought by compulsive force . . . . and thus to resist, and undo, and frustrate, and mar the work of the controlling all-compelling power—but an expression of the power or will of the power or powers of evil constantly opposing and resisting the power of God or good?"

Man loves light now, and has ever loved it; in early

days, even in Bible times, clouds and darkness, opposition to or hindrance of light, had been taken as antagonistic to the wishes of man, but the Omniscient decreed otherwise. The compelling power of light is the sole earthly cause of what man calls repulsion; there is no escape from this while light lasts; animate and inanimate, the mass, the atom, the vapour and the gas, the dew and the rain, the mountains, plains, and seas could not be as they are without the action of light on matter more or less sensitive to it. The Creator gave the matter and the light. There is no antagonism, no power of evil, and the Major apparently accepts this wondrous, merciful, and beautiful system of creation.

At p. 281 he finds "a world of disorder, a wild confusion of atoms each in the grasp only of repulsive force—an earth 'without form,' and then comes compulsive force or light upon the scene"—and this earth was born.[1]

At p. 284 he comes back to the point. "For since we see that repulsive force is almost as necessary to our well-being as compulsive force, it is clear that a fair amount of resistance or opposition is good." It has been pointed out in the text that as no two gases have the same acceptance of light, so this power must act differently on all organic or inorganic matter that has been formed from, or which may contain some of the gases. Major Sedgwick was on the verge of truth; there was no evil in God's work—that has come from man; what he calls the repulsive was not only "almost as necessary," it was indispensable and in unity with the light as, says the Major at p. 286, "it is connected with God and God's habitation."

[1] Section 2.

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"SUNLIGHT."

From the Salisbury and Winchester Journal, Nov. 17, 1888.

SIR.—About a year ago you were good enough to honour my little book with a favourable notice. Since then science in two periodicals has called it fiction, unworthy of notice, and unfortunate that such books should be published, as they mislead those who cannot discriminate between fact and fiction. There never was a time in the history of England when fiction was more eagerly swallowed than it is at present. Perhaps some of your readers will understand from the following brief extracts that the fiction on the subject before us is an invention of science. My thesis was that light is the motor of things sensitive to it; and that the sea had sunk by the sinking of its bed—hence dry land. The *Mail* of 5th inst. gives us "the influence of sunlight on trees"—several familiar examples are given, and the "leaves which are developed under the full influence of sunlight" are larger and thicker and "have a larger number of breathing pores than those less exposed to light."

On the 7th inst. the same paper had a note on the "Secular Depression of Land in France." A long series of observations has been carried on "for the purpose of detecting any variation of level in the land." It has been found that some portions are not and some are sinking, so that if "this rate of depression continue, North-Eastern France will, in the course of a few centuries, encounter a calamity similar to that which befell the Netherlands"—that is, it will be under the sea. We have many examples of this local sinking in our coal fields. About the same time that "Sunlight" was published, Mr. Forster, telegraph manager at Zante, published a pamphlet on the frequent sinkings of the sea bed, the fracture of cables, the consequent subsidence of the sea, and hence more dry land. It will be obvious to anyone that when water moves under the surface of its bed, or of the land, it must move matter with it; hence sapping is always going on, and the surface must subside sooner or later.—Your obedient servant,

H. P. MALET.

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